24 LSI MARK II

Installation and Operation

Racal-Milgo®

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Installation and Operation

MODEM 24 LSI MARK II

Racal-Milgo™

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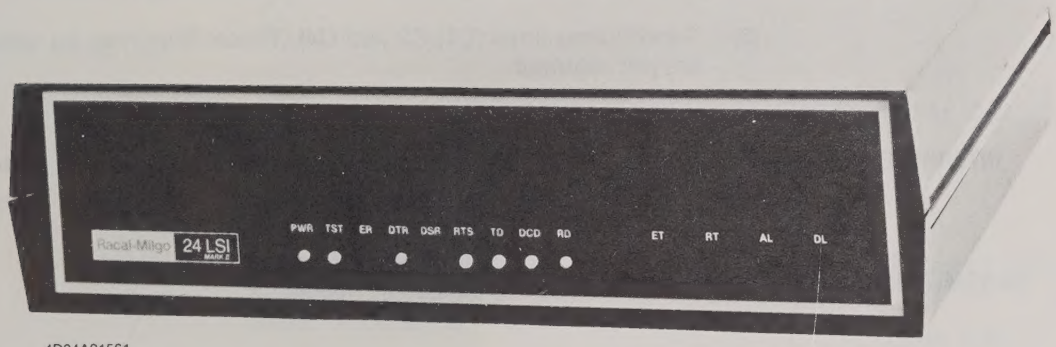


Frontispiece: Modem 24 LSI MARK II, Part No. 4404-24A

POWER REQUIREMENTS

Modem 24 LSI MARK II may be equipped with one of two power supplies available:

(a) For domestic (USA) applications, power supply, Part No. 4404-24AD-1, operates from an ac power source of 105 to 125 Vac, 50-65 Hz. Power consumption is 15 Watts maximum.

(b) For foreign country applications power supply, Part No. 4404-24AJ-1, is set to operate from one of the following ac power sources:

(100) 89-112 Vac., 47-65 Hz.
(115) 105-132 Vac., 47-65 Hz.
(200) 178-224 Vac., 47-65 Hz.
(230) 210-264 Vac., 47-65 Hz.

Power consumption for any of the four ac power sources is 15 Watts maximum.*

DATA TRANSFER RATE

Information is transmitted and received at 2400 bps (1200 Baud), synchronous.

*The power cord attachment plug cap supplied with this modem is rated for use at 125 V. For use at 200 (nom) or 230 (nom) volts this plug must be replaced by one of the correct rating.

SPECIFICATIONS (Continued)

TELEPHONE LINE REQUIREMENTS

Modem 24 LSI MARK II operates on 2-wire (half-duplex) or 4-wire (full duplex) circuits over any of the following telephone line facilities:

(1) Public switched (DDD-PSTN) telephone line networks.

(2) Type 3002 unconditioned, private (leased) telephone lines.

(3) Conditioned lines (C1, C2 and C4). These lines may be used, but are not required.

INTERFACE

Modem 24 LSI MARK II conforms to the interface specifications defined in EIA-RS232C/CCITT, V.24.

TRANSMITTER

DATA INPUT

Format	Serial binary data.
Amplitude	EIA-RS232C/CCITT V.24 ±3V to ±25V (+) = 0 or Space (−) = 1 or Mark
Input Line	Single wire, ground return.
Input Load	3000 - 7000 ohms.

OUTPUT TO LINE

Output Signal	Differential 4-phase modulation on an 1800 Hz carrier; CCITT, V.26, B pattern.
Output Level	Strap adjustable, in 2 dB increments, from 0dBm to −14dBm.
Output Impedance	600 ohms, nominal.
Digital to Analog Delay	3 ms.

CLOCK

Waveform	Squarewave: negative going edges coincide with center of data bits; positive going edges coincide with change of input data.
Frequency	For external use: fixed 2400 Hz 50% ±1% duty cycle. From external source: 2400 Hz 50% ±5% duty cycle.

SPECIFICATIONS (Continued)

Accuracy	±0.01%
Amplitude	For external use: EIA-RS232C/CCITT V.24 standard, ± (10 ±1) V from approximately 300-ohm source. From external source: EIA-RS232C/CCITT V.24 standard, ±3V to ±25V into 3000 to 7000 ohms.

RECEIVER

INPUT FROM LINE

Input Signal	Differential 4-phase (DPSK) modulation on 1800 Hz carrier. CCITT V.26 B pattern.
Input Impedance	600 ohms, nominal.
Input Level	Modems without Feature D+R1, D+R2, or D+L2, between 0dBm and −40dBm in two strap selectable ranges: 0dBm to −30dBm for private lines; −10dBm to −40dBm for dial-up lines. Modems with Feature D+R1, D+R2, or D+L2, between −10dBm and −46dBm in two strap selectable ranges: −10dBm to −40dBm for normal dial-up lines; −16dBm to −46dBm for low-level dial-up lines.
Analog to Digital Delay	2 ms.

DATA OUTPUT

Format	Serial binary data.
Amplitude	EIA-RS232C/CCITT V.24.
Output Line	Single wire, ground return.
Output Impedance	Approximately 300 ohms.

CLOCK

Waveform	Squarewave: negative going edges coincide with the center of data bits; positive going edges coincide with change in output data. Derived from received signal.
Frequency	Equal to data bit rate; synchronized with the remote transmitter clock.
Amplitude	For external use: EIA-RS232C/CCITT V.24.
Tracking Capability	The receiver bit serial timing circuits track 2400 bps frequency variations up to ±0.02%.

SPECIFICATIONS (Continued)

SELECTABLE FUNCTIONS	
TRANSMITTER	
RTS-CTS Delay Basic	133.3 ms in 2-wire operation. 8.3 ms in 4-wire operation.
RTS-CTS Delay Strap Selectable	33.3 ms or 66.7 ms for 4-wire operation.
Carrier Control	Turn on and turn off delay, 3 ms.
RECEIVER	
DCD Delays Dropout Delays	5 to 15 ms.
Return Delay Recovery	6.5 to 8.0 ms.
RECEIVER CARRIER CONTROL (RCC)	
Squelch Delay	None.
Unsquelch Delay	50 ms (2-wire only).
DIMENSIONS AND WEIGHTS	Modem dimensions and weights are as follows:

Height . . . . . 3.44 inches (8.74 cm)
Width . . . . . 13.83 inches (35.13 cm)
Depth . . . . . 12.10 inches (30.73 cm)
Weight . . . . . 12 pounds (5.44 kg)

WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

SECTION 1

INTRODUCTION

GENERAL INFORMATION

Modem 24 LSI MARK II (Frontispiece), Racal-Milgo, Inc. Part No. 4404-24A, is a stand-alone, table top data set that transmits and receives data at a rate of 2400 bits per second (bps) on 2-wire half-duplex or 4-wire full or half-duplex circuits. Communication with other modems in a point-to-point or multipoint network is achieved over dedicated (leased) unconditioned telephone lines CCITT grade M1020 ATT type 3002; conditioned lines CCITT type 1040, ATT type C1, C2, or C4 may also be used but are not required. Public switched (DDD-PSTN), dial-up telephone line service can also be used in the communications network as a backup to dedicated line service.

Modem 24 LSI MARK II is online compatible with Racal-Milgo, Inc. Modems CS 24 LSI MARK II, 24 LSI, 2200/24, and WECo 201B and 201C Data Sets when these devices are strapped for 2400 bps and B pattern modulation.

FUNCTIONAL DESCRIPTION

Figure 1-1 shows the functional sections of Modem 24 LSI MARK II.

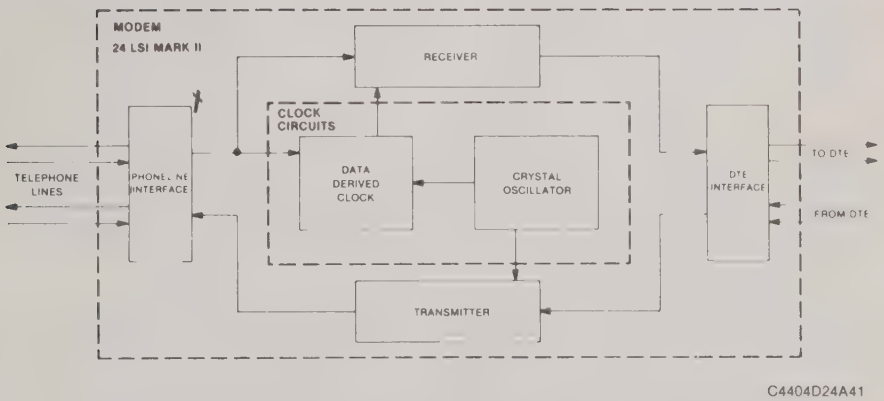


Figure 1-1: Modem 24 LSI MARK II, Simplified Block Diagram

TRANSMITTER

Information from the data terminal equipment (DTE) enters the transmitter section (Figure 1-1) as synchronous, serial, binary data, at a transfer rate of 2400 bps. The transmitter modulator encodes the data bits, two bits at a time, to produce a differential four phase signal centered on an 1800 Hz. carrier. This modulated carrier conveys the information through the telephone line.

RECEIVER

The modulated 1800 Hz carrier signal from the telephone line is accepted by the receiver section (Figure 1-1). To compensate for line attenuation, the received signal is preamplified. The receiver demodulator circuits extract the data and restore it to its original format. The digital 2400 bps data are transferred through the interface to the data terminal equipment (DTE).

EQUALIZER

Inherent passband characteristics of the telephone lines may result in phase and amplitude distortion of the modulated carrier. To compensate for this distortion, Modem 24 LSI MARK II contains a statistical equalizer circuit which can be strap connected in either the transmit or the receive path, or strap disabled, as required, for each specific application.

CLOCK CIRCUITS

The clock circuits comprise a highly stable crystal oscillator and a data derived clock. The crystal oscillator is the main source of timing control for transmitter and receiver operation. The data derived clock extracts the timing component from the signal received over the telephone line and synchronizes the crystal oscillator timing with the extracted timing. The data synchronized clock signal controls receiver operation.

INTERFACE

Modem 24 LSI MARK II conforms to the interface specifications defined in EIA-RS232C/CCITT, V.24.

POWER SUPPLY

The main PC Card in all Modems 24 LSI MARK II is provided with power supply rectifiers, filters, and regulators. The power transformer, fuse, power ON/OFF switch, and power cord are integral parts of the modem.

PHYSICAL DESCRIPTION

The basic functions of Modem 24 LSI MARK II are contained in the main PC (Printed Circuit) Card, Part No. 4404-24AAA. This PC Card also contains dc power regulator and customer DTE (Data Terminal Equipment) interface circuits, as well as pushbutton switches, light indicators, and terminal connectors. The prime ac power control circuits are mounted within the modem housing.

The modem is housed in a two-piece metal case with slide-in front and rear panels. The main PC Card is mounted on the base of the housing case next to the power transformer. The selected optional PC Card is mounted on stand-off posts provided on the main PC Card. A ribbon type multiconductor cable interconnects the main PC Card and feature PC Card.

CONFIGURATION DATA

Modem 24 LSI MARK II is made available with its basic functions (Feature A), as well as with a variety of special added functions. These functions are identified by feature code in Table 1-1. Each modem has a name plate on the rear panel, where part number, configuration code, and serial number of the modem are shown. When contacting the Racal-Milgo Customer Representative to request modem servicing, the part number, configuration code, and serial number must be provided.

MODEM CONFIGURATIONS

All Modems 24 LSI MARK II have identical front panel appearance, regardless of feature configuration. The rear panels are also identical, with the exception of the location of the J2 connector, which is used in one of four different ways to suit feature operation.

FEATURE A

This is the basic modem which provides the normal data communications functions. Additionally, the basic modem provides the following test mode functions:

ET - Error Test
RT - Receive Test or Remote Test (Feature A + T1)
AL - Analog Loopback Test
DL - Digital Loopback Test (usable only in 4-wire operation)

The basic modem has external connections for the Data Terminal Equipment (DTE-J1) and private 2-wire or 4-wire telephone lines.

FEATURE A + S2

This feature performs the normal and test mode functions of the basic modem, and the Secondary Channel (S2) function, which is performed by circuits in the feature PC Card, Part No. 4404-24AE-2.

The Secondary Channel employs FSK modulation of a 419 Hz. center frequency, for asynchronous data transmission and reception, 4-wire service only, at a data speed rate of up to 150 bps.

Feature A + S2 includes Splitting Adapter, Part No. 4402K96A, which provides separate female outlets for DTE primary channel and secondary channel cable connectors. The adapter, as well as the 4-wire telephone lines, are respectively connected to J1 and TB1 on the rear panel (Figure 3-7).

FEATURE A + S7

This feature performs the normal and test mode functions of the basic modem, and the Tertiary Channel (S7) function, which is performed by circuits in the PC Card, Part No. 4404-24AL. This feature is available only when accompanied by the S2 or T7 features.

The Tertiary Channel operates up to 75 bps on the high end (3180 Hz) center frequency. Since this frequency is beyond the guaranteed frequency range of a 3002 line, C4 conditioning may be required for S7 operation. C4 lines may not be available in all areas, especially in multidrop applications. In these cases, C2 conditioning will help and will enable operation on 90 to 95% of these lines.

The S7 option operates on 4-wire lines only, and may be used for switched or continuous carrier, full or half duplex operation. Transmission and reception are independent of the ET, RT, AL, and DL tests of the modem's primary channel.

FEATURE A + T1

This feature performs the normal and test mode functions of the basic modems, and the Point-to-Point Test (T1) function, which is performed by circuits in the PC Card, Part No. 4404-24AF-1.

The Point-to-Point Test circuits provide 392 Hz. or 447 Hz. tone transmission and reception. Thus, in a 4-wire point-to-point network having modems equipped with the T1 feature, the modem at one end of the line can command the modem at the other end of the line to go into a digital loopback (392 Hz tone) or an analog loopback (447 Hz tone) test mode.

Rear Panel external connections are made to J1 from the DTE, and to TB1 from 4-wire or 2-wire telephone lines.

FEATURE A + T2

This feature performs the normal and test mode functions of the basic modem, and the Central Site Multipoint Test (T2) function. This function uses the modem transmitter amplifier to send encoded 392 Hz and 447 Hz

FSK signals generated by the Model 160 Multipoint Tester (MT).

Remote site modems in the Multipoint network must be Feature A + T3 modems. With this network configuration, Model 160 MT sends address and command codes through the central site (T2) modem to each addressed remote site modem.

FEATURE A + T3

In addition to normal and test mode functions of the basic modem, Feature A + T3 has the Remote Site Multipoint Test (T3) function. This function is generated by circuits in PC Card 4404-24AF-3.

Feature A + T3 modems recognize address poll and command codes from the Model 160 MT connected to a Feature A + T2 modem at the central site. The command codes force the addressed remote site modem into analog or digital loopback test. Feature A + T3 has FSK signal reception and demodulation controls only; no FSK transmission control is supplied with this feature.

FEATURE A + T7

In addition to the normal functions of the basic modem, Feature A + T7 has PC Card, Part No. 4404-24AE-1, which generates the Multipoint Test and Control (T7) function.

In a multipoint network, the central site A + T7 modem is connected through receptacle J1 to a System 185 or 200 Network Diagnostic Controller (NDC). DTE 185 Split Cable, Part No. 5956-100D-XX, is required to simultaneously connect modem to DTE and NDC. Remote sites in the network must be equipped with Feature A + T7 modems.

The T7 PC Card contains a transmitter, receiver, and microprocessor which operate 75 baud, asynchronous secondary channel (center frequency at 419 Hz) between central site and remote site modems equipped with the T7 PC Card. Thus, from the central site, the NDC can monitor and test the performance of a remote site modem.

FEATURE A + J2

In addition to the normal and test mode functions of the basic modem, Feature A + J2 has a special signal interface at receptacle J2. The AUX J2 receptacle interface is provided by daughter PC Card, Part No. 4404-24AK-1, which is mounted on stand-off posts and connected to the main PC Card by 40-conductor ribbon cable. Feature A + J2 modems can be connected to one of the following two optional devices:

- Model 16 Voice Adapter
- Model 160 MT equipped with cable 4402-601E, which has a 25-pin female conductor.

The daughter PC Card has an option strap which sets the modem for operation with the Voice Adapter or the Multipoint Tester.

Feature A + J2 modems can also be connected to a Model 121 Auto Line Adapter. However, with Feature A + J2 the ALA is restricted to local operation in manual mode, and excludes the Monitor Test and Control (T7) function.

FEATURE D+R1

In addition to normal and test functions of the basic modem, Feature D + R1 provides Dial-Up Interface and Programmable RCD (Registered Connecting Device) functions. Dial-Up Interface allows modem and DTE to operate auto answer or manual answer on dial-up lines.

A Programmable RCD controls the modem transmit signal to insure that the signal reaches the telephone company central office at the optimum level of – 12dBm.

The R1 Feature functions are performed by PC Card, Part No. 4404-24AG-1. The J2 location is occupied by the FCC Approval nameplate and the modular line cord exit.

FEATURE D+R2

In addition to the normal and test mode functions of the basic modem, Feature D + R2 provides Dial-Up Interface and Permissive RCD functions. Dial-Up Interface allows modem and DTE to operate on auto answer or manual answer on dial-up lines. Permissive RCD limits the modem transmit signal at – 9dBm. Only permissive connections are allowed behind a Private Branch Exchange (PBX) or Call Director (Key Telephone System - KTS).

The R2 Feature functions are performed by PC Card, Part No. 4404-24AG-2. The J2 location is occupied by the FCC Approval nameplate and the modular line cord exit.

FEATURE D+L2

In addition to the normal and test mode functions of the basic modem, Feature D + L2 provides Automatic Answer and Automatic Disconnect in dial-up operation. With the L2 Feature, the modem automatically seizes the dial-up line when a call arrives from an external RCD (Registered Connecting Device) or DAA (Data Access Arrangement) coupler. The line is held until the data exchange is completed. The Feature D + L2 PC Card can be strapped for automatic disconnect. The D + L2 Feature is performed by PC Card, Part No. 4404-24AN-1.

OPTIONAL EQUIPMENT

Racal-Milgo, Inc. offers a variety of optional external equipment to facilitate the operation of Modem 24 LSI MARK II, and add to its capabilities. This optional equipment, described in Table 1-2, generally operates with Features A + J2, A + T2 and A + T7.

The Installation and Operation Manual provided with each optional device supplies its connection to the modem and the operation instructions.

Table 1-1: Modem 24 LSI MARK II, Configuration

UNIT DESIGNATION	UNIT PART NO.	FEATURE IDENTIFICATION
Feature A	4404-24A-25	Basic Modem
Feature A + H2	4404-24A-26	Slide Rack
Feature A + H3	4404-24A-48	Fixed Panel Rack
Feature A + S2	4404-24A-67	Secondary Channel
Feature A + S2 + H2	4404-24A-69	Slide Rack
Feature A + S2 + H3	4404-24A-66	Fixed Panel Rack
Feature A + S7 + T7	4404-24A-88	Tertiary Channel with T7 Option
Feature A + S7 + T7 + H2	4404-24A-89	Tertiary Channel with T7 Option and Slide Rack
Feature A + S7 + T7 + H3	4404-24A-90	Tertiary Channel with T7 Option and Fixed Panel Rack
Feature A + S7 + S2	4404-24A-39	Tertiary Channel with S2 Option
Feature A + S7 + S2 + H2	4404-24A-40	Tertiary Channel with S2 Option and Slide Rack
Feature A + S7 + S2 + H3	4404-24A-50	Tertiary Channel with S2 Option and Fixed Panel Rack
Feature A + T1	4404-24A-17	Point-to-Point Remote Test
Feature A + T1 + H2	4404-24A-18	Slide Rack
Feature A + T1 + H3	4404-24A-58	Fixed Panel Rack
Feature A + T2	4404-24A-21	Central Multipoint Test
Feature A + T2 + H2	4404-24A-22	Slide Rack
Feature A + T2 + H3	4404-24A-59	Fixed Panel Rack
Feature A + T3	4404-24A-37	Remote Multipoint Test
Feature A + T3 + H2	4404-24A-38	Slide Rack
Feature A + T3 + H3	4404-24A-52	Fixed Panel Rack
Feature A + T7	4404-24A-85	Multipoint Test and Control
Feature A + T7 + H2	4404-24A-86	Slide Rack
Feature A + T7 + H3	4404-24A-87	Fixed Panel Rack
Feature A + J2	4404-24A-54	Auxiliary Connector
Feature D + R1	4404-24A-91	Dial-up Operation with Built-in RCD Programmable Mode
Feature D + R1 + H2	4404-24A-92	Slide Rack
Feature D + R1 + H3	4404-24A-93	Fixed Panel Rack
Feature D + R2	4404-24A-95	Dial-up operation with Built-in RCD Permissive Mode
Feature D + R2 + H2	4404-24A-96	Slide Rack
Feature D + R2 + H3	4404-24A-97	Fixed Panel Rack
Feature D + L2	4404-24A-27	Automatic Answer and Disconnect. External RCD Interface

Table 1-2: Modem 24 LSI MARK II, Optional Equipment

EQUIPMENT	PART NO.	PURPOSE	REQUIRED FEATURE
Model 160 MT	4405-3A	Model 160 Multipoint Tester (MT) generates address poll and command codes which are transferred to a central site modem to force the remote addressed modem into digital or analog loopback test.	A + T2
System 185 NDC	4407-21B	System 185 Network Diagnostic Controller (NDC) is a stand alone, central site monitoring and fault isolation device for up to 16 (expandable using remote Digital Mixing Modules) central sites, each connected to a multipoint network. The network modems must be Feature A + T7.	A + T7
System 200 NDC		System 200 Network Diagnostic Controller (NDC). This system is based on a programmable computer which provides automatic surveillance and fault isolation for up to 64 remote sites in a multipoint network. The network modems must be Feature A + T7.	A + T7
Model 121A Auto Line Adapter	4404-121B	Provides capability to switch modem between private and dial-up telephone lines; also, automatic answer in a 4-wire networks. Switching can be done manually or automatically. Model 121A operates with System 185 NDC or System 200 NDC and a modem Feature A + T7. This arrangement permits the dial-up connection to be held, and switching between dial and private lines to be tested and verified.	A + T7 A + J2
Model 23C Multiline Adapter	4402-93C	Provides ac bridge for dial backup service in multipoint polled networks. Requires no changes to hardware or software of the installation.	All Feature A Modems
Model 16 Voice Adapter	A11-01E-0002	Provides capability for alternate voice/data communications over 4-wire private (leased) telephone lines.	A + J2

SECTION 2

PREINSTALLATION INSTRUCTIONS

GENERAL INFORMATION

This section contains an analysis of the network environment in which Modem 24 LSI MARK II is to be installed. A preinstallation check routine and list of tools required for the installation are also included.

The typical data communications network is composed of Data Terminal Equipment (DTE), modems, and transmission lines. Since modems are directly connected to DTE and to transmission lines, each modem is provided with option straps which must be correctly selected to match performance characteristics of associated DTE and transmission lines.

STRAPPING SELECTIONS

Option straps select such modem operation parameters as transmit signal level, RTS-CTS delay, etc., which are required at the time of installation, and which may change from time to time at a particular site. Option straps may be removable black or yellow jumper plugs which are connected to upright pins at appropriately labelled locations on the PC Cards; switchbanks which can be set to the appropriate positions; or soldered jumpers which can be clipped out or unsoldered, and removed to suit different operating conditions.

Table 2-1 describes the option straps and illustrates the strap locations for the main PC Card. Tables 2-2 through 2-8 describe the option straps for the special function PC Cards.

NETWORK CONFIGURATIONS

BASIC NETWORKS

The manner in which modems are connected to one another through transmission lines determines the network configuration. There are three basic network configurations: Point-to-Point (Figure 2-1), Multidrop (Figure 2-2), and Multipoint (Figure 2-3). Multipoint is a combination of point-to-point and multidrop. The three basic configurations are also found in more complex patterns, such as point-to-point with repeater site, multichannel point-to-point, and extended interface networks. For each configuration, there are specific characteristics which must be matched at the modem by strap selections.

VF bridges, shown in Figures 2-2 and 2-3, are line impedance couplers supplied by the telephone company. These bridges have one input and generally four outputs. A typical 600-ohm impedance appears at both input and output of a VF bridge. All unused bridge outputs must be terminated with a 600-ohm resistor.

Failure to terminate VF bridge unused output or outputs impairs the balanced impedance characteristic of the bridge. As a result, the modems connected to the bridge receive signal reflections which make equalization difficult.

Figure 2-1: Point-to-Point Network

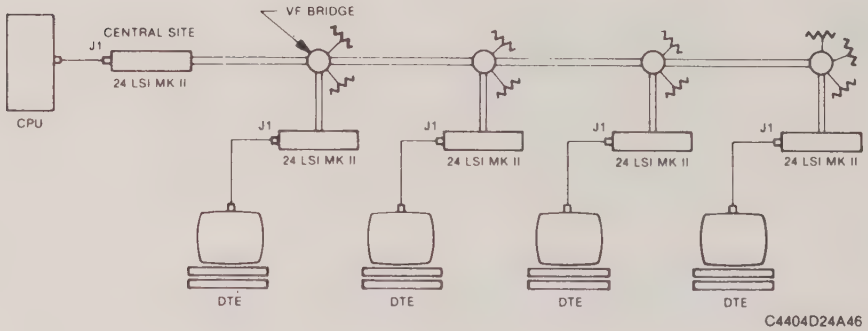


Figure 2-2: Multidrop Network

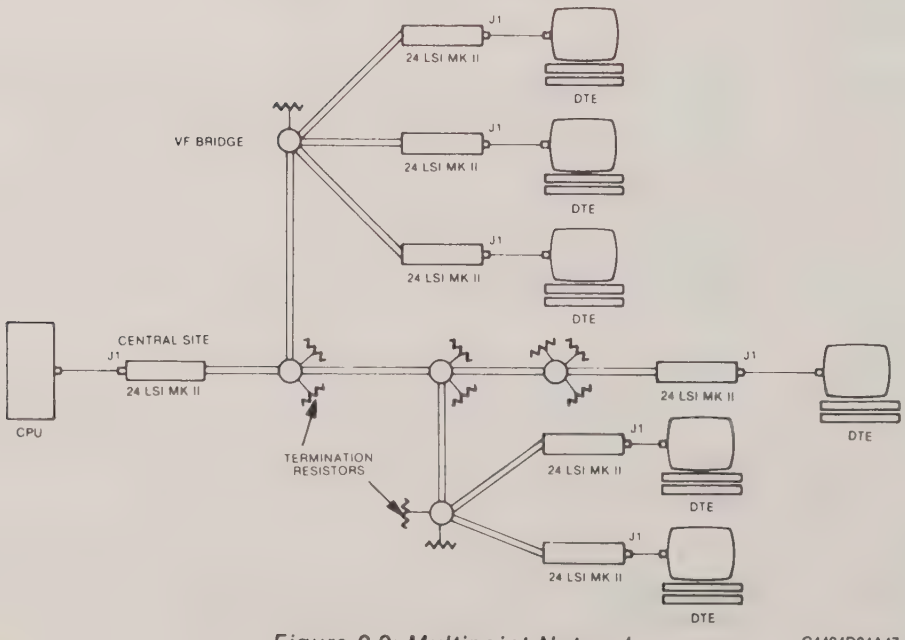


Figure 2-3: Multipoint Network

POINT-TO-POINT NETWORK WITH REPEATER SITE

Long distance, private line communication between two modem sites can be subject to considerable signal quality degradation and attenuation. To reduce these conditions, repeater modems are occasionally installed midway between the two end sites. Figure 2-4 shows a long distance communication link using two Modems 24 LSI MARK II connected back-to-back (J1 to J1) as repeater modems. Signal wiring for cable 5956-109A interconnecting the two repeater modems is also shown in Figure 2-4.

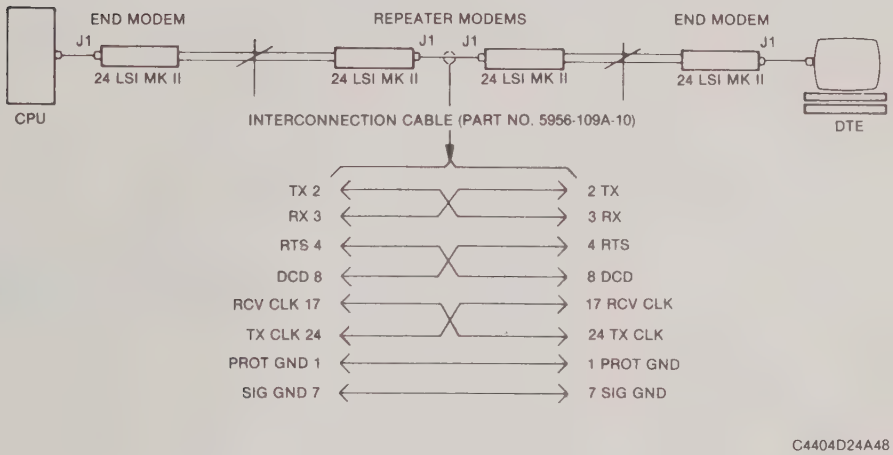


Figure 2-4: Point-to-Point Network with Repeater Modem Site

MULTICHANNEL POINT-TO-POINT NETWORK

In this network configuration (Figure 2-5), three computer ports (2400 bps) are connected to two point-to-point Modems MPS 7201 or 9601, and two computer ports (2400 bps) are connected to two point-to-point Dual Port MPS 48 modems. The point-to-point modems carry up to three communication links over a long distance, 4-wire, private transmission line "trunk".

The far-end modems act as distribution points, where the "trunk" is separated into single channels. Each channel is interfaced by cable 5956-109A to short distance, point-to-point 24 LSI MARK II modems.

EXTENDED INTERFACE NETWORK

Extended interface (Figure 2-6) is provided by a short distance point-to-point configuration of two 24 LSI MARK II modems. One of these modems is directly connected to a computer port; the other modem is connected to a console which acts as a distribution center.

In the network in Figure 2-6, the distribution center serves two point-to-point configurations with 24 LSI MARK II modems, and two directly interfaced DTEs.

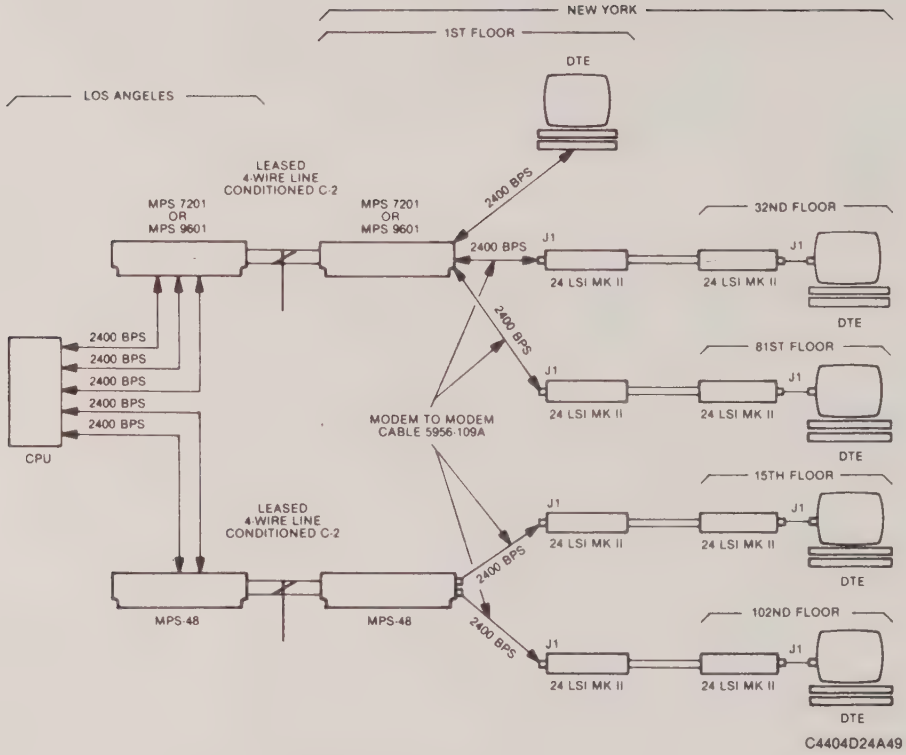


Figure 2-5: Multichannel Point-to-Point Network

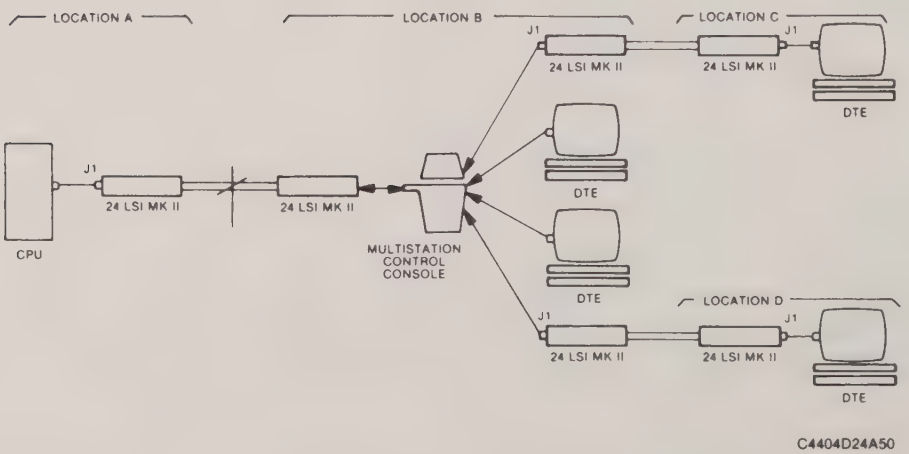


Figure 2-6: Extended Interface Network

NETWORK CONSIDERATIONS

TRANSMITTER TIMING

TX TIMING strap (Table 2-1). Set repeater modems for external TX timing. Connect repeater modems with cable 5956-109A.

In remote port applications (Figure 2-7), the central site modem assumes the master clock function for all modems in the network. The receiver at the far-end modem derives the master clock signal and uses it as clock source receive (RX pins strap) to control its data transmission. Thus, the central site receives data which is frequency locked to the original master clock signal.

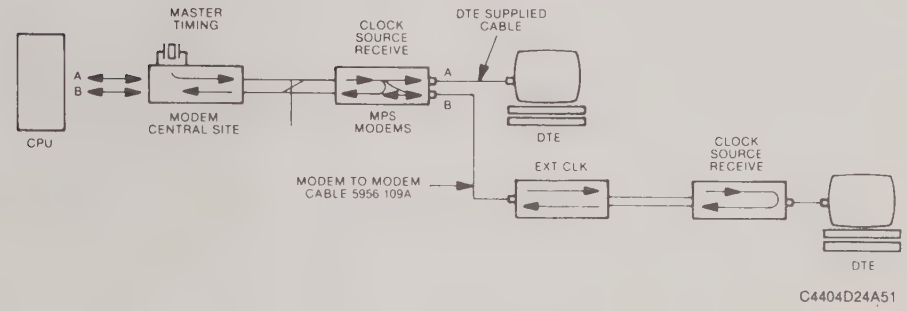


Figure 2-7: Master Timing Distribution in an Extended Interface Network

Cable 5956-109A carries the clock source receive signal from the MPS modem to the first remote 24 LSI MARK II modem (J1-24); therefore, this modem is strapped at the EX pins.

The farthest 24 LSI MARK II modem in the network receives data synchronized to the original master clock signal, and uses this signal (RX pins strap) to control its data transmission back toward the central site. Thus, timing in the 24 LSI MARK II modems is slaved to the central site master clock timing control.

CARRIER CONTROL

The CARRIER strap selection sets the modem transmitter to generate a modulated carrier in one of two ways: either continuously (continuous carrier) or under control of the RTS signal from the terminal equipment (switched carrier, also called controlled carrier).

Continuous or switched carrier selection depends on network requirements.

Example A: In a point-to-point, half-duplex network, both end modems must be set to switched carrier. These settings allow half-duplex data traffic control; first in one direction, then in the opposite direction.

Example B: In a point-to-point, full duplex network, both end modems may be set for continuous carrier. These settings allow the simultaneous, two-way data traffic of full duplex.

Example C: In a multidrop or multipoint, full duplex network, it is customary to set the central site modem for continuous carrier and the remote site modems for switched carrier. These settings allow the remote site modems to "talk back" to the central site modem one at a time.

Whenever possible, continuous carrier operation is advisable because it results in high throughput. Controlled carrier reduces throughput due to switching (turn-around) delay from transmission to reception.

RTS-CTS DELAY

In a network using repeater (regenerative) modems (Figure 2-4), the end modems should be set for 33.3 ms RTS-CTS delay; the repeater modems, for 8.3 ms RTS-CTS delay. Refer to Table 2-1.

In a multipoint network or point-to-point 4-wire network with no repeater modems, (Figures 2-1 and 2-3) strap set all modems for 8.3 ms RTS-CTS delay.

In a modem strapped for continuous carrier operation, CTS is always on and, therefore, there is no RTS-CTS delay.

The short RTS-CTS delay (8.3 ms) results in higher throughput. However, the longer RTS-CTS delay may be used as a fallback emergency setting in case of data transfer errors due to an incorrectly equalized telephone line. It is possible to strap the modem at one end for short RTS-CTS delay and the modem at the other end, for long RTS-CTS delay.

TRANSMISSION LINE CONSIDERATIONS

TRANSMIT LEVEL

For private (dedicated) transmission lines, strap the modem 0dBm transmit level which provides optimum S/N (signal to noise ratio) at the receiving end.

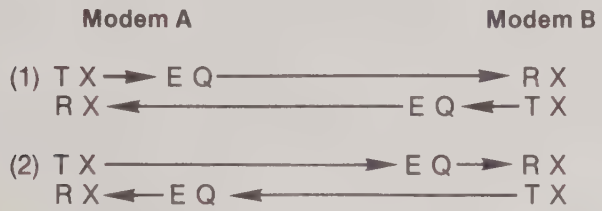
Modem main board 0dBm transmit level strapping is required by the telephone company for Feature D + R1 and D + R2 modems connected to dial-up lines.

The transmit level for Feature D + L2 modems is determined by the requirements of Permissive or Programmable operation of the dial-up line coupler; for example, Model 68 RCD (registered connecting device). Refer to Instruction Manual, Part No. 4402D207A1.

EQUALIZER

EQL Strap: Modem 24 LSI MARK II strap options permit the equalizer stage to be connected to the transmit or receive path, or to be disconnected from both paths. In selecting the path for equalizer strapping, insure that only one equalizer stage is connected between the transmitter at one modem, and the receiver at the other modem.

In a point-to-point network, the equalizer must be connected in one of two ways:



In a Multipoint Network, the following criteria apply to long distance communication links: a) if the central site modem has its equalizer strapped in its transmitter path, all remote site modems also must have their equalizers strapped in their transmitter paths; b) if the central site modem has its equalizer strapped in its receiver path, all remote site modems also must have their equalizers strapped in their receiver paths.

In some highly conditioned line links, the equalizer may provide undesirable over compensation and, therefore, should be strapped out at both end modems.

RECEIVE PREAMPLIFIER GAIN CONTROL

With normal data reception (no errors or no significant error rate), set the RX PREAMPLIFIER to –30dBm for private (dedicated) lines, and set it to –40dBm for dial-up lines.

DTE CONSIDERATIONS

TRANSMITTER TIMING

Most customer equipment terminals (DTE's) are synchronized with transmitter timing internally generated by the modem. In such a case, place the TX TIMING strap on IN (internal) pins.

At times, the DTE or an external master clock source provides the modem with external transmitter timing. In such a case, place the strap on EX (external) pins.

RECEIVE CLOCK CONTROL

The RCLK strap serves to fulfill a DTE requirement: the DTE may require that the Receiver Signal Element Timing at J1-17 of the modem be continuously present; in that case, strap the modem at the RUN pins. Otherwise, the DTE may require that the Receiver Signal Element Timing be made available only when the DCD signal is present; in that case, strap the modem at the GATE pins.

NEW SYNC

Strap A. The New Sync signal (Table 2-1) is applicable to a central site modem which polls numerous remote site modems. Without New Sync, the

DCD signal (J1-8) which is normally delayed by the modem after the carrier drops (dead time), prevents DTE fast switching from one remote site to the next.

The DTE generates the New Sync signal when it detects ETX (End of Text) or EOM (End of Message) during a block transmission. Immediately upon receipt of New Sync the modem drops DCD, resynchronizes with the new carrier and again raises the corresponding DCD signal to the DTE.

DTE COMPATIBILITY

Modem 24 LSI MARK II requires that the Data Terminal Equipment (DTE) have standard EIA RS-232C or CCITT V.24 Interface capability.

EQUIPMENT GROUND

For operator's safety and the correct operation of the equipment, it is recommended that circuit ground and chassis (frame) ground be joined at one designated, common point in the equipment.

Modem 24 LSI MARK II provides the GND JUMPER (X8) to join circuit and chassis grounds from the DTE and the modem. The DTE ground lines are transferred to the modem through the DTE interface cable (J1-1 and J1-7).

The X8 jumper should be removed only when the common ground is provided elsewhere; for example at the DTE. This action is usually due to "ground circuit loops" which may cause excessive signal noise.

PREINSTALLATION CHECKS

Before modem installation, perform the following checks:

(1) Ensure that data terminal equipment (DTE) interface cable does not exceed 50 feet (15.2 meters) and that physical location of modem allows connection of cable to data terminal equipment.

(2) Check connecting cable lengths to ensure that the modem can be connected without stressing DTE, transmission line, or ac power cables.

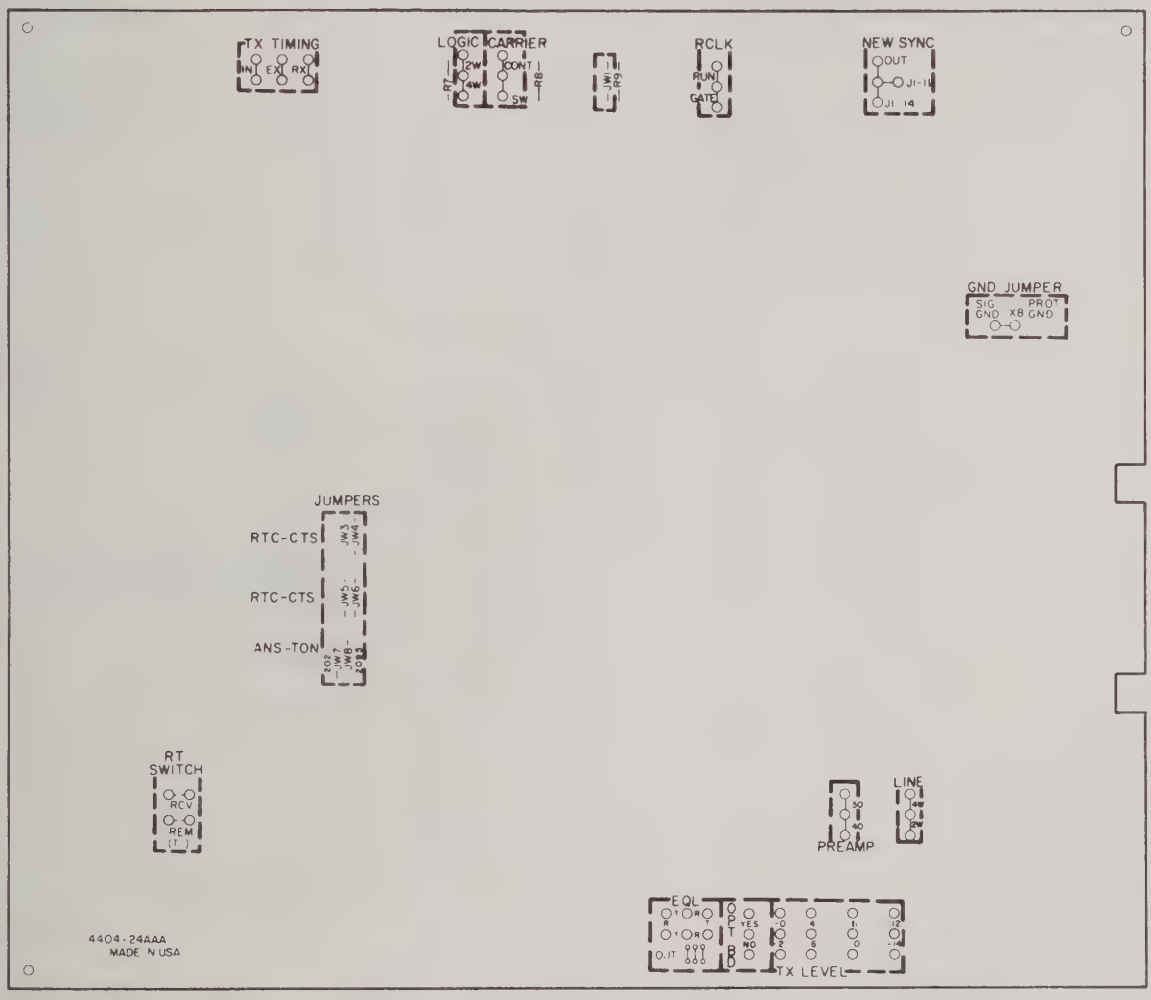
(3) Make every effort to see that DTE and modem are plugged into ac power outlets which are connected to the same ground line. The DTE/modem interface may be subject to "noise" interference when separate ac or ground sources are used.

(4) Check that modem is installed within 10 feet (3 meters) of a grounding type ac outlet.

(5) Check that voltage at ac power outlet is the same as that for which the modular units are set to operate; refer to SYSTEM CONNECTIONS, AC Power Source.

(6) Check that transmission lines have been installed for the modem(s).

Table 2-1: Main PC Card, Strap Options



STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
TX Timing	Internal	IN	Modem transmitter supplies its own timing.
	External	EX	Modem transmitter accepts external timing J1-24.

Table 2-1: Main PC Card, Strap Options (Continued)

STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
TX Timing (Continued)	Receiver Timing	RX	Modem transmitter is supplied timing derived from receiver timing. Applies to 4-wire operation only.
Logic	Two-Wire Half-Duplex	2W	Modem operates on 2-wire, half-duplex.
	Four-Wire Full Duplex	4W	Modem operates on 4-wire, full duplex.
Carrier	Continuous Transmit Carrier	CONT.	Continuous transmit carrier selected. Applies to 4-wire operation only.
	Switched Carrier	SW	Switched carrier selected.
RCLK	Constant	RUN	Receive Clock signal appears constantly at J1-17.
	Clamped	GATE	Receive Clock signal at J1-17 is clamped to +V when DCD is off.
New Sync	Not Used	OUT	New Sync signal is not used.
	J1-11 Used	J1-11	New Sync signal from J1-11 is used.

Table 2-1: Main PC Card, Strap Options (Continued)

STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
New Sync (Continued)	J1-14 Used	J1-14	New Sync signal from J1-14 is used.
RT Switch	Receive Test	RCV	The RT switch on the modem front panel has the Receive Test (receive only) function.
	Remote Test	REM	The RT switch on the modem front panel has the Remote Test function. Applies to Feature A + T1 modem only.
Preamp	Range 0 to −30dBm	−30	Receive signal level range is 0 to −30dBm.
(Note)	Range −10dBm to −40dBm	−40	Receive signal level range is −10dBm to −40dBm.
Line	Four-Wire Full Duplex	4W	Modem operates on 4-wire, full duplex.
(Note)	Two-Wire Half-Duplex	2W	Modem operates on 2-wire, half-duplex.
EQL	Transmit Path	TX	Install three straps as shown to connect equalizer in the transmit path.
	Receive Path	RX	Install three straps as shown to connect equalizer in the receive path.

Table 2-1: Main PC Card, Strap Options (Continued)

STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
EQL (Continued)	Not Desired	OUT	Install three straps as shown when equalizer operation is not desired.
OPT BD	Basic Modem	NO	Install strap as shown for Feature A (basic) modem operation only.
	Feature Code	YES	Install strap as shown for operation with modems of any feature code, except Feature A (basic).
TX Level	0dBm	0	Transmit Level = 0dBm. This strap setting is required for Feature D + R1 and D + R2 modem operation.
	– 2dBm	– 2	Transmit Level = – 2dBm.
	– 4dBm	– 4	Transmit Level = – 4dBm.
	– 6dBm	– 6	Transmit Level = – 6dBm.
	– 8dBm	– 8	Transmit Level = – 8dBm.
	– 10dBm	– 10	Transmit Level = – 10dBm.

Table 2-1: Main PC Card, Strap Options (Continued)

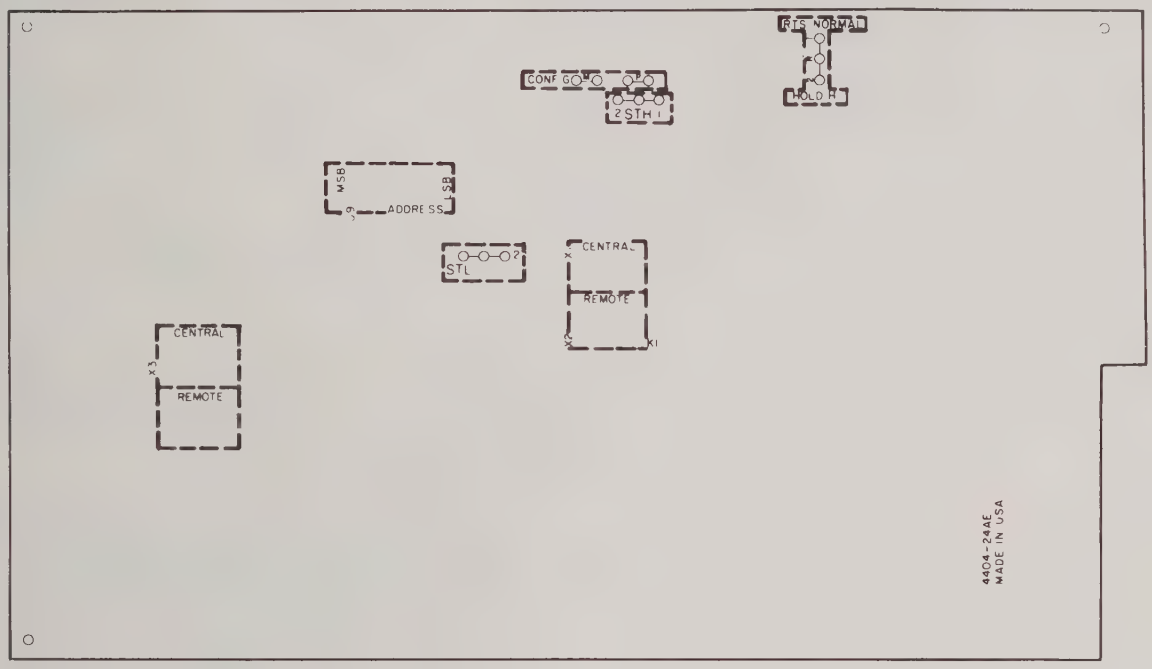
STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
TX Level (Continued)	– 12dBm	– 12	Transmit Level = – 12dBm.
	– 14dBm	– 14	Transmit Level = – 14dBm.
DSR Connect/ Disconnect (AL Test)	DSR drops	JW1-IN (F)	AL test mode causes DSR signal to drop (Factory set).
	DSR Not Inhibited	JW1-OUT	Jumper removed. AL test mode does not inhibit DSR Signal.
RTS-CTS Delay Selection	8.3 (4-wire) 133.3 (2-Wire)	JW3-OUT (F) JW4-IN (F) JW5-OUT (F) JW6-IN (F)	RTS-CTS Delay = 8.3 ms in 4 wire = 133.3 ms in 2 wire
	33.3 (4-Wire) 133.3 (2-Wire)	JW3-IN JW4-OUT JW5-OUT JW6-IN	RTS-CTS Delay = 33.3 ms in 4 wire = 133.3 ms in 2 wire
	66.6 (4-Wire) 133.3 (2-Wire)	JW3-OUT JW4-IN JW5-IN JW6-OUT	RTS-CTS Delay = 66.6 ms in 4 wire = 133.3 ms in 2 wire
	133.3 (2 and 4 Wire)	JW3-IN JW4-OUT JW5-IN JW6-OUT	RTS-CTS Delay = 133.3 ms in both 4 wire and 2 wire.
Answer Tone Frequency	2021 Hz	JW7-IN (F) JW8-OUT	A 2021 Hz Answer Tone is generated (Factory set).
	2095 Hz	JW7-OUT JW8-IN	A 2095 Hz Answer Tone is generated.

Table 2-1: Main PC Card, Strap Options (Continued)

STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Signal GND to Chassis GND Connnection	Connected	X8-IN (F)	Signal Ground and Chassis Ground are connected (Factory set).
	Disconnected	X8-OUT	Signal Ground and Chassis Ground are disconnected.

NOTE: The Preamp and Line strap settings have no effect in Feature D + R1 and D + R2 modem operation. The Preamp function is included in the R1/R2 PC Card.

Table 2-2: Multipoint Test and Control (T7) PC Card, Strap Options



STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Central/ Remote Site	Central Site	CENTRAL	The T7 PC Card has two strap locations identified as CENTRAL/REMOTE. For central site modems install a 7-strap block in the two CENTRAL locations.
	Remote Site	REMOTE	For remote site modems install a 7-strap block in the two REMOTE locations.
Address	Site Address Code	Switchblock 1 2 3 4 5 6 7 8	Use Switchblock S1 to compose the binary, 8-bit site address code. Each of the eight rocker switches depressed to the upper positions represents a one (1); depressed to the lower position it represents a zero (0). Switch labelled 1 is Most Significant Bit (MSB).

Table 2-2: Multipoint Test and Control (T7) PC Card, Strap Options (Continued)

STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Address (Continued)			Switch labelled 8 is Least Significant Bit (LSB). Example: MSB LSB 0 1 0 1 1 0 0 1 Address = 89
RTS Control	RTS Normal	NORMAL 1 ● R ● 2 ●	The RTS signal provided by the customer terminal (DTE) operates normally.
	RTS Held Hi	1 ● R ● 2 ● HOLD HI	RTS signal input to the T7 control is held constantly high. Use this strap setting with a DTE which does not provide RTS signal, and with repeater central/site modems in Multidrop Networks.
Config.	Multipoint Network	M P ● ● ● ●	Strap setting for modems in Multipoint (polled) networks.
	Point-to-Point and Multidrop (Repeater Modems)	M P ● ● ● ●	Strap setting for modems in point-to-point networks, and repeater modems in multidrop networks.
Anti-Streaming Threshold STH-STL	2 Second Limit	S T H ● ● ● 1 2 S T L ● ● ● 1 2	These two strap settings limit anti-streaming timer to 2 seconds.
(See Note)	15 Second Limit	S T H ● ● ● 1 2 S T L ● ● ● 1 2	These two strap settings limit anti-streaming timer to 15 seconds.

Table 2-2: Multipoint Test and Control (T7) PC Card, Strap Options (Continued)

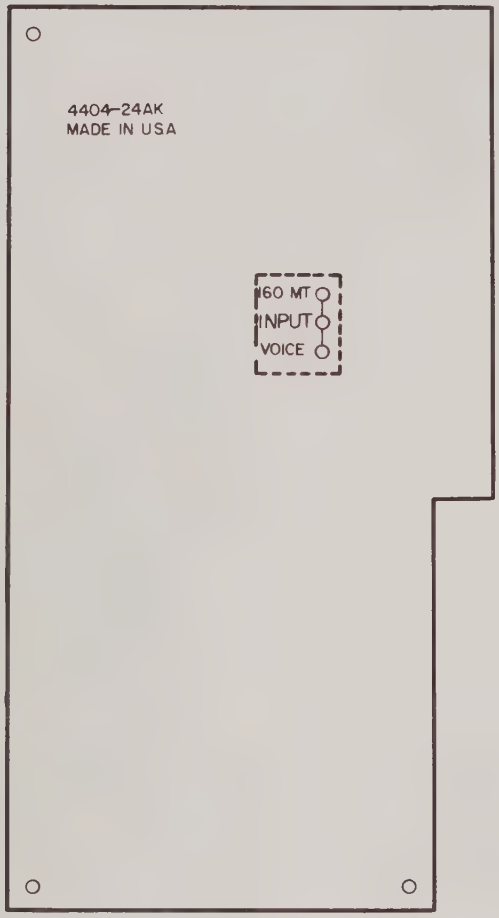
STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Anti-Streaming Threshold STH-STL (Continued)	29 Second Limit	S T H 1 2 S T L 1 2	These two strap settings limit anti-streaming timer to 29 seconds.
	43 Second Limit	S T H 1 2 S T L 1 2	These two strap settings limit anti-streaming timer to 43 seconds.

NOTE: All central site modems should be strapped for the next longer anti-streaming time than their associated remote site modems.

Table 2-3: Secondary Channel (S2) PC Card, Strap Options

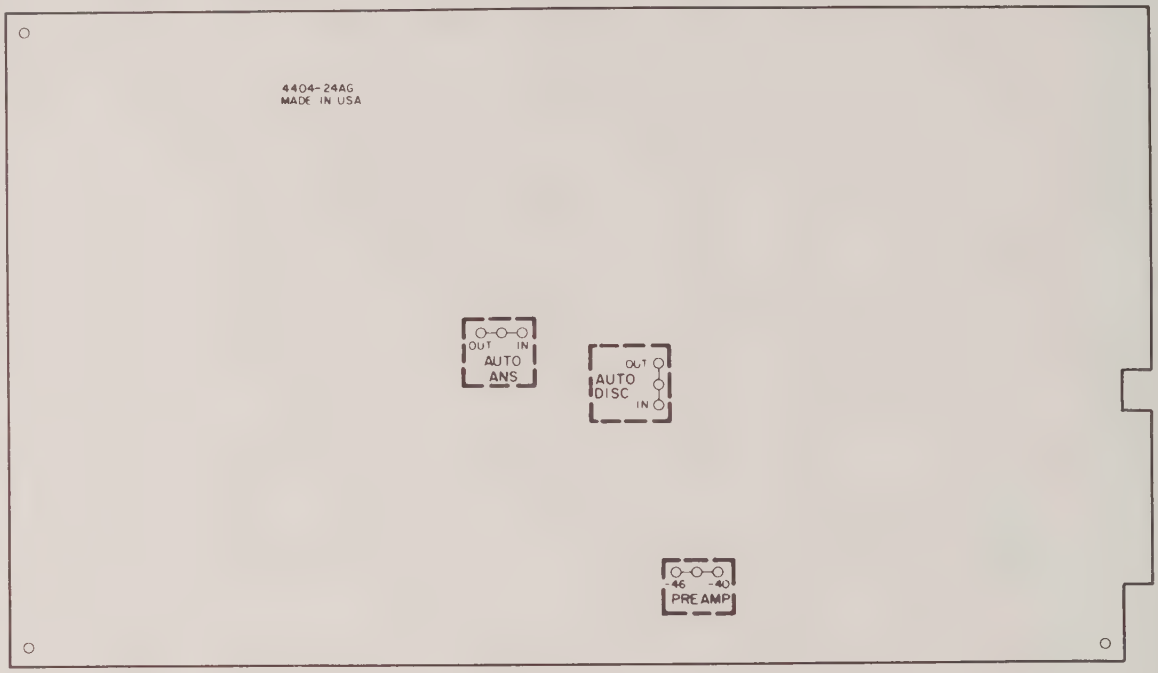
STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Carrier Control Selection	Switched	JW15-IN (F)	Jumper connected. Secondary Channel operates on switched carrier (Factory set).
	Continuous	JW15-OUT	Jumper removed. Secondary Channel operates on continuous carrier.

Table 2-4: Special Interface (A + J2) PC Card, Strap Options



STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Input Selection	Model 160 Multipoint Tester	160 MT	Sets modem for operation with Model 160 Multipoint Tester.
	Model 16 Voice Adapter	VOICE	Sets modem for operation with Model 16 Voice Adapter.

Table 2-5: Dial-Up (R1 and R2) PC Card, Strap Options

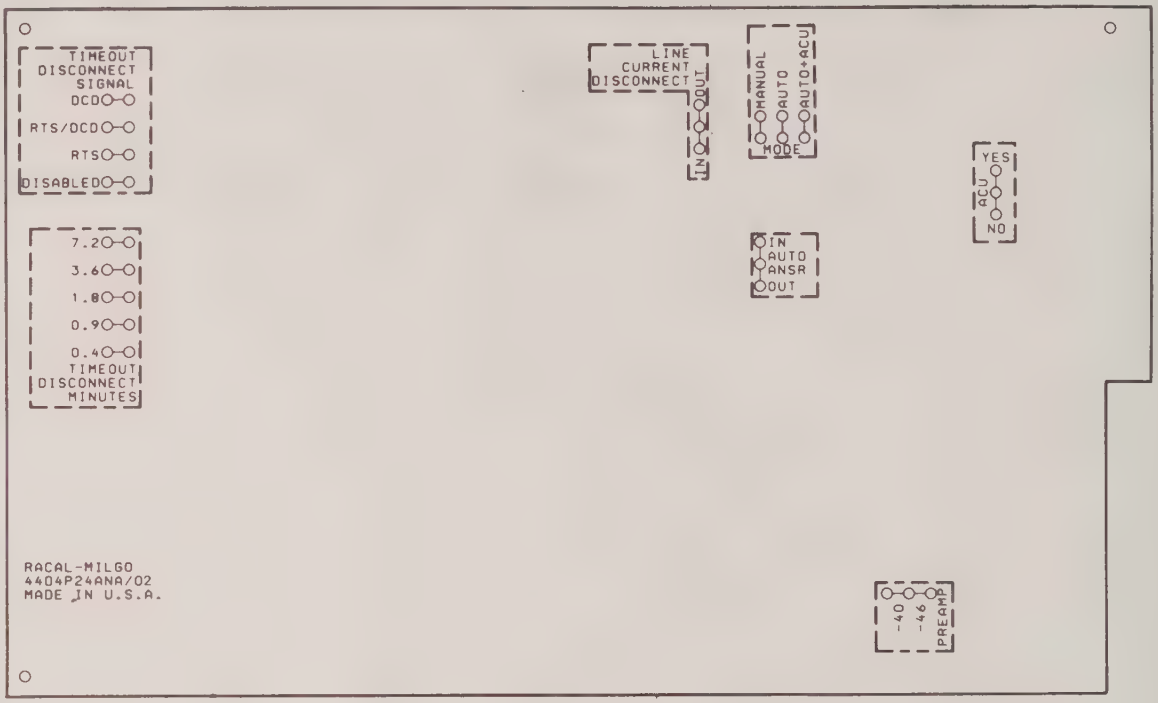


STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Auto Ans	Not Auto	OUT	Modem does not answer incoming calls automatically.
	Auto	IN	Modem answers incoming calls automatically whenever DTR signal is on and/or the ET pushbutton is depressed.
Auto Disc	No Disc	OUT	Removal of line holding current (LCSI) does not cause line disconnect.
	Disconnect	IN	Removal of line holding current (LCSI) causes line disconnect.

Table 2-5: Dial-Up (R1 and R2) PC Card, Strap Options (Continued)

STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Preamp	Dropout at −40dBm	−40	DCD signal dropout occurs at −40dBm.
	Dropout at −46dBm	−46	DCD signal dropout occurs at −46dBm.

Table 2-6: Automatic Answer and Disconnect (L2) PC Card, Strap Options



STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Auto Answer	Auto Answer Not Desired	IN / AUTO ANSR / OUT	Modem does not answer an incoming call automatically.
	Auto Answer	IN / AUTO ANSR / OUT	Modem automatically answers telephone calls, provided: a) DTR signal is on, b) modem is not on ET mode; c) DL pushbutton is not depressed.
Line Current Disconnect	Modem Ignores LCSI	OUT	Modem ignores Line Current Status Indication (LCSI) from RCD.
	LCSI Disconnects	IN	LCSI signal from RCD causes modem to disconnect the line.

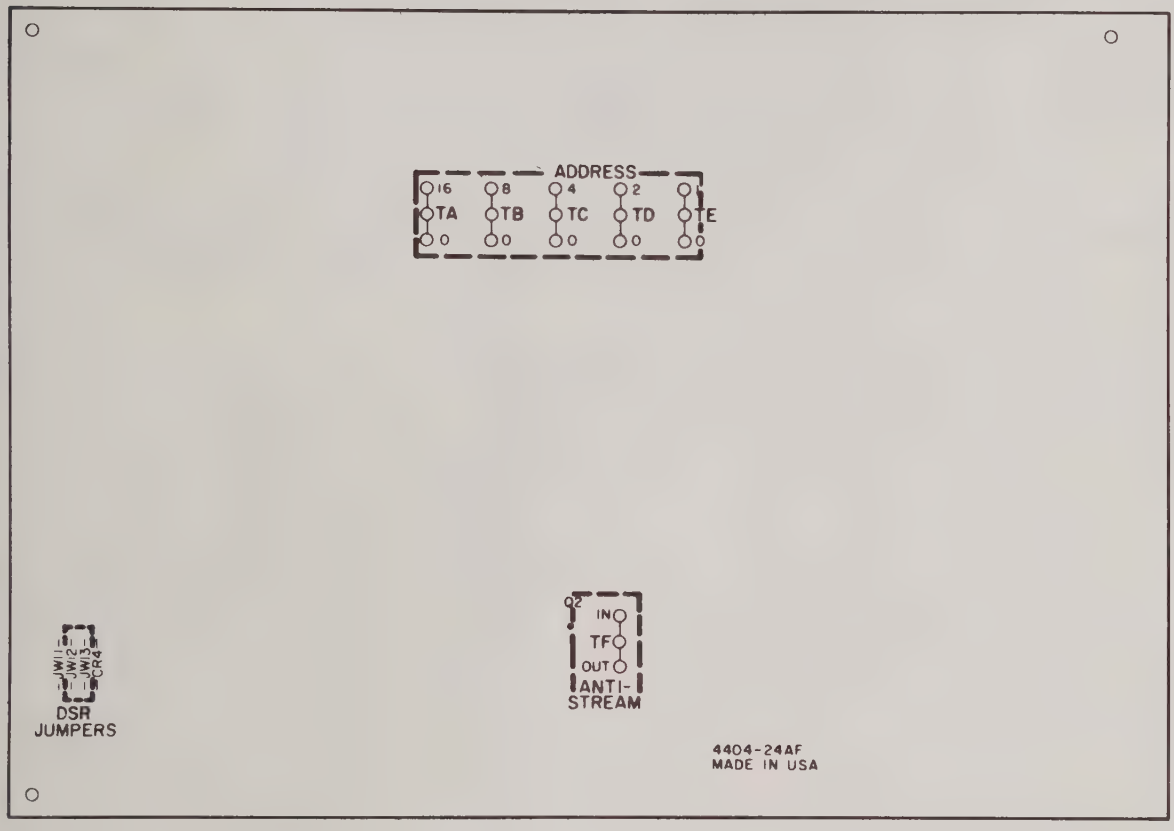
Table 2-6: Automatic Answer and Disconnect (L2) PC Card, Strap Options (Continued)

STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Mode	Manual RCD	MANUAL	Strap MANUAL when associated RCD is manual type.
	Auto RCD	AUTO	Strap AUTO when associated RCD is automatic type.
	Automatic Calling Unit	AUTO + ACU	Strap AUTO + ACU when associated automatic type RCD operates with an automatic calling unit.
ACU	Automatic Calling Unit	YES	Strap YES when an automatic calling unit (ACU) is used.
	No Automatic Calling Unit	NO	Strap NO when no ACU is used.
Preamp	DCD Dropout at – 40dBm	– 40	DCD signal dropout occurs at – 40dBm.
	DCD Dropout at – 46dBm	– 46	DCD signal dropout occurs at – 46dBm.
Time Out - Disconnect Signal (This Strap is interrelated with TIME OUT DISCONNECT MINUTES Strap)	Disconnect/ DCD Off	DCD	Line disconnect occurs if DCD signal is off for a selected period of time.
	Disconnect/ RTS Off	RTS	Line disconnect occurs if RTS signal is off for a selected period of time.

Table 2-6: Automatic Answer and Disconnect (L2) PC Card, Strap Options (Continued)

STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Time Out Disconnect Signal (Continued)	Disconnect/ RTS or DCD Off	RTS/DCD	Line disconnect occurs if either RTS or DCD signal is off for a selected period of time.
	No Disconnect/ RTS or DCD Off	DISABLED	No line disconnect occurs if either RTS or DCD signal is continuously off.
Time Out Disconnect Minutes	Signal May Be Off 7.2 Minutes	7.2	Either or both RTS and DCD signal may be off for 7.2 minutes before line disconnect occurs.
	Signal May Be Off 3.6 Minutes	3.6	Either or both RTS and DCD signal may be off for 3.6 minutes before line disconnect occurs.
	Signal May Be Off 1.8 Minutes	1.8	Either or both RTS and DCD signal may be off for 1.8 minutes before line disconnect occurs.
	Signal May Be Off 0.9 Minutes	0.9	Either or both RTS and DCD signal may be off for 0.9 minutes before line disconnect occurs.
	Signal May Be Off 0.4 Minutes	0.4	Either or both RTS and DCD signal may be off for 0.4 minutes before line disconnect occurs.

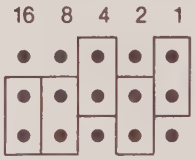
Table 2-7: Test Module (T3) PC Card, Strap Options



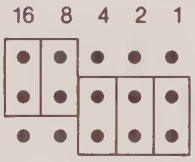
STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
DSR Control	Inhibited in Test Modes And When TF Out	JW12-OUT (F) JW13-IN	The DSR signal is inhibited in all test modes, and when the 30-second anti-streaming timer is disabled (strap TF OUT). (Factory Set)
	Inhibited During DL And AL Only	JW12-IN JW13-OUT	The DSR signal is inhibited during AL or DL test mode only.
Anti-Stream	Timer Enabled	TF IN	The 30-second antistreaming timer is enabled.

Table 2-7: Test Module (T3) PC Card, Strap Options (Continued)

STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Anti-Stream (Continued)	Timer Disabled	TF OUT	The 30-second antistreaming timer is disabled.
Address	The assigned address code is composed in binary form. Install one strap on each of the five strap locations: TA, TB, TC, TD, and TE. See examples:		

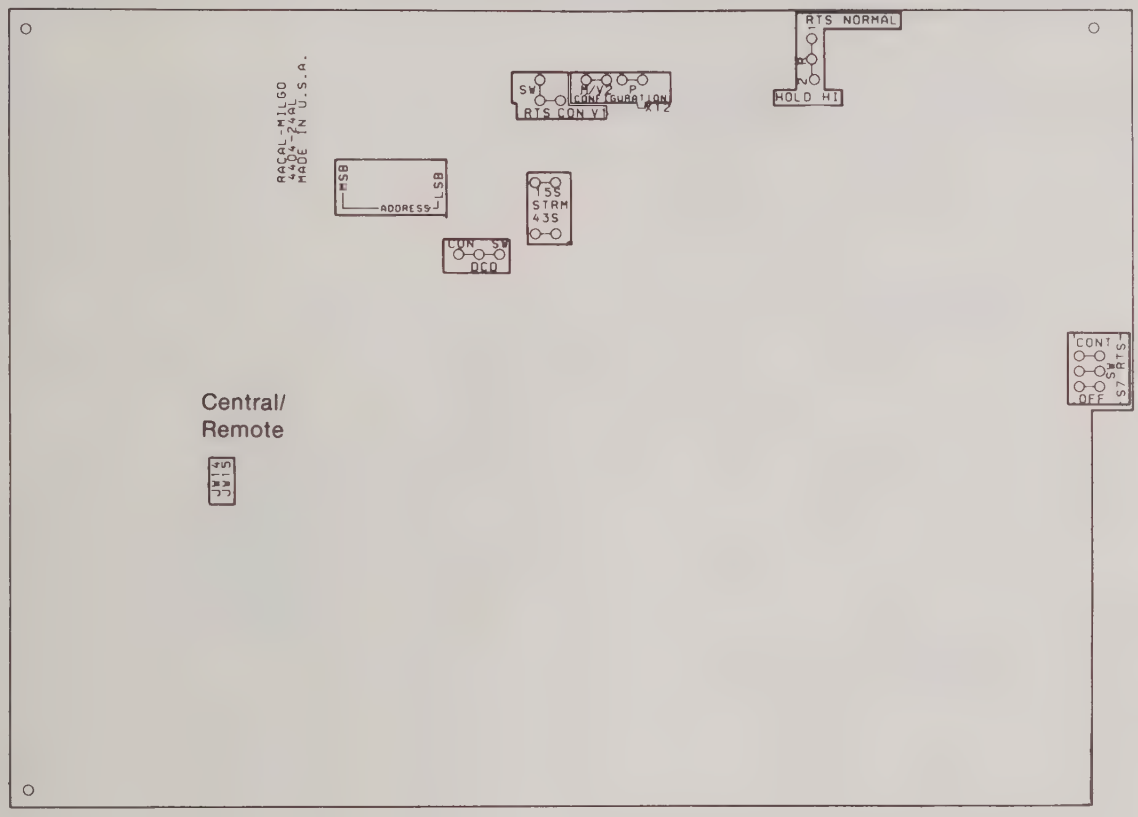


Address 5 = 4 + 1
(0 0 1 0 1)



Address 24 = 16 + 8
(1 1 0 0 0)

Table 2-8: Tertiary Channel (S7 + S2/S7 + T7) PC Card, Strap Options



STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
RTS	Continuous	SW ● RTS ●● CON	RTS interface signal is continuously ON. (This must be strapped for use with V1 T7 option.)
	Switched	SW ●● RTS ●● CON	RTS interface signal is switched.
Configuration	Multipoint	●●●● M/V2	Multipoint configuration (polled). Must be used with all version 2 T7, regardless of modem configuration.

Table 2-8: Tertiary Channel (S7 + S2/S7 + T7) PC Card, Strap Options (Continued)

STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Configuration (Continued)	P-to-P	P	For use with point-to-point configurations with version 1 T7. This is used when there is constant carrier sent in each direction. This position is also used in repeater modems in a multidrop configuration to inhibit streaming alarms during test.
RTS	Normal	RTS NORMAL	RTS from interface is observed normally.
	Hold Hi	HOLD HI	The RTS input to T7 is held at a constant positive level. Used only with DTE's which do not provide RTS, and for repeater/central modems in multidrop configurations.
DCD	Continuous	CON	DCD interface signal is continuously ON. This position produces 29S streaming timer with version 1 T7.
	Switched	SW	DCD interface signal is switched. This position produces 43S streaming timer with V1 T7.
STRM	15 Sec	15S	RTS anti-streaming timer is 15 seconds.
	43 Sec	43S	DCD anti-streaming timer is 43 seconds.
Central/ Remote Modem	Central	Install plug-in headers in positions X1 and X3 "Central" sockets.	Central Site Modem operation.
	Remote	Install plug-in headers in positions X2 and X4 "Remote" sockets.	Remote Site Modem operation.

Table 2-8: Tertiary Channel (S7 + S2/S7 + T7) PC Card, Strap Options (Continued)

STRAP DESIGNATION	STRAP OPTION	STRAP POSITION	FUNCTION SELECTIONS
Address Switch			These switches determine a binary coded T7 address. S1A is the Most Significant Bit (MSB); S1H is the Least Significant Bit (LSB). Example: Address = 5
S7 RTS	Continuous		Continuous carrier operation on S7 tertiary channel. The S7 CTS signal is always positive.
	Switched		Switched carrier operation on S7 tertiary channel. The S7 CTS signal goes positive 120 ms after the S7 RTS signal goes positive.
	Off		No transmission is permitted over the S7 tertiary channel.
JW15	Switched	IN	JW15-IN for switched transmit carrier over S2 channel.
	Continuous	OUT	JW15-OUT for continuous transmit carrier over S2 channel.

SECTION 3

INSTALLATION INSTRUCTIONS

GENERAL INFORMATION

This section contains the necessary instructions for on-site installation of Modem 24 LSI MARK II. The instructions include installation instructions, DTE and transmission line system connections, and preoperational confidence tests.

RACK MOUNT INSTALLATION

Units equipped with a sliding rack mount or fixed panel mount are shown in Figures 3-1, 3-3, 3-4, and 3-5.

Rack mount kits are also available as a separate item. The sliding rack mount kit is Part No.4404-163D-2, and the fixed panel rack mount kit is Part No. 4404-158C.

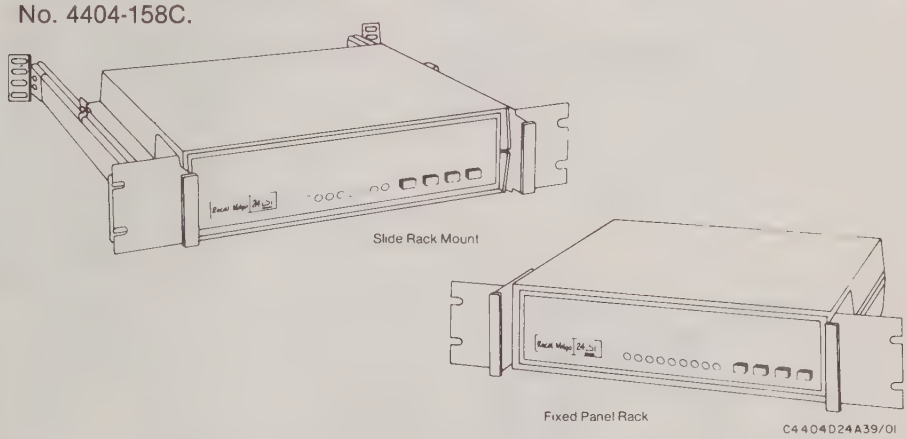
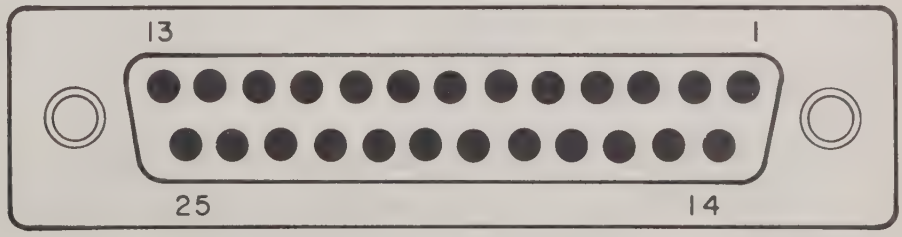


Figure 3-1: Rack Mount Models

SYSTEM CONNECTIONS

DATA TERMINAL EQUIPMENT (DTE) CONNECTIONS

DTE receptacle J1 (Figure 3-2) is a standard 25-pin female receptacle. Connect the DTE to receptacle J1 of the modem (Figure 3-6). Use cable with Cinch or Cannon DB-25B male plug, or equivalent (the Cinch plug also requires a DB-51226-1A hood.) Table 3-1 gives the pin/signal assignments for DTE receptacle J1.



A4404D84A22

25 - Pin Female Connector, Pin Numbering Convention

Figure 3-2: DTE Receptacle J1, Data Terminal Equipment Interface

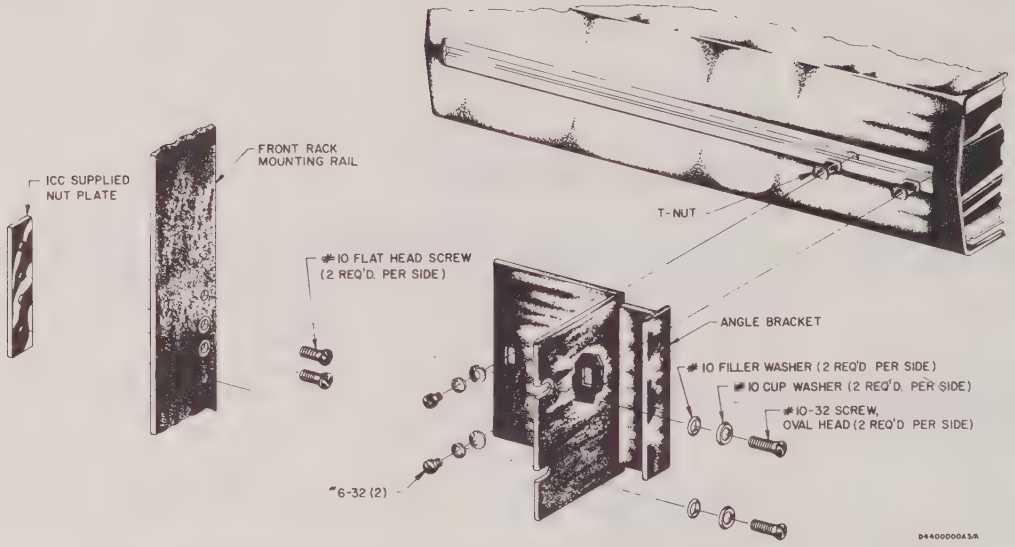


Figure 3-3: Fixed Bracket Relationship to Modem (Kit Part No. 4404-158C)

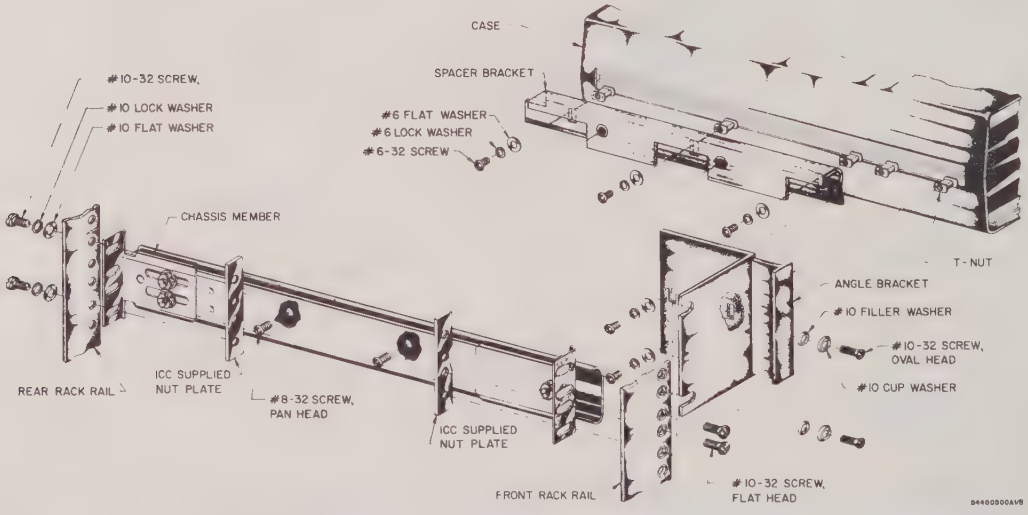


Figure 3-4: Sliding Rack Mount Relationship to Modem (Kit Part No. 4404-163-D)

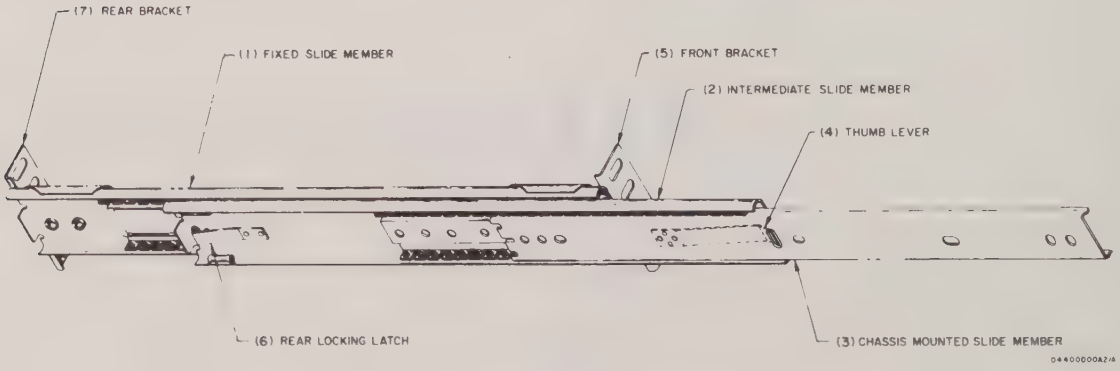
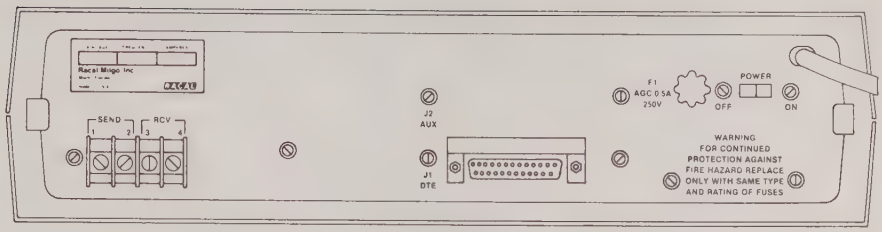
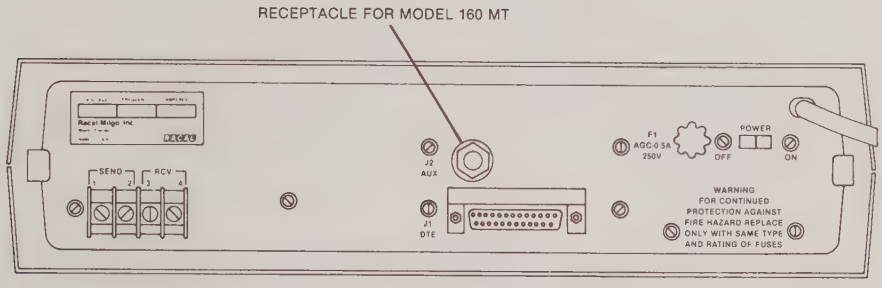


Figure 3-5: Rack Mount Slide Member Major Parts

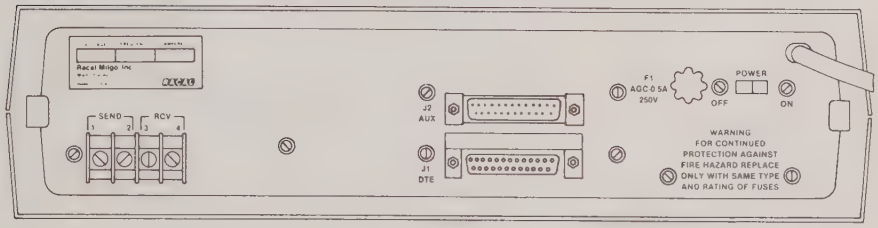
Features A, A+2
A+T1 and A+T3



Feature A+T2



Features A+T7
and A+J2



Features D+R1
and D+R2

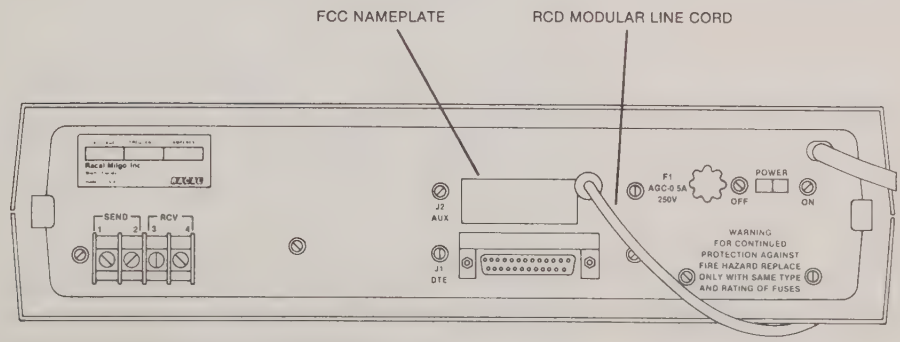


Figure 3-6: Modem Rear Views

For Feature A + T7 use DTE/185 NDC Split Cable, Part No. 5956-100D-XX (Figure 3-7), to connect DTE and System 185 to J1 receptacle in the modem.

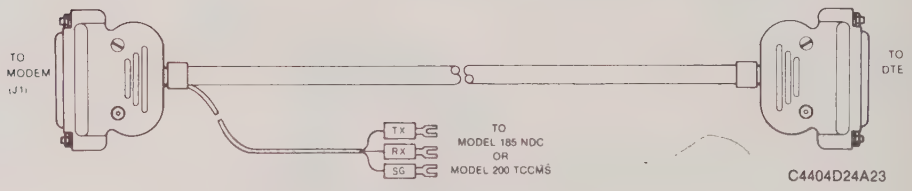


Figure 3-7: DTE/185 NDC Split Cable, Part No. 5956-100D-XX

For Feature A + S2 modems use Splitting Adapter, Part No. 4402K96A (Figure 3-8), to connect DTE and secondary channel to J1 receptacle in the modem.

PRIVATE TELEPHONE LINE CONNECTIONS

Modems Feature A + J2, A + T1, A + T2, A + T3, and A + T7; use terminal block TB1 to connect the required 4-wire telephone lines. Terminals 1 and 2 are for the send pair, and terminals 3 and 4 are for the receive pair.

Modem Feature A can be connected to 4-wire, or 2-wire (TB1 terminals 1 and 2) private telephone lines.

Connect private lines to the modem with 25 AWG, or heavier, twisted pair.

DIAL-UP TELEPHONE LINE CONNECTIONS

Modem Connections. In the 24 LSI MARK II family of modems, Features D + R1 and D + R2 are the only units designed for auto answer or manual operation with, and direct connection to dial-up, 2-wire telephone lines.

To provide direct connection to dial-up lines, Feature D + R1 and D + R2 modems are registered with the Federal Communications Commission (FCC). Refer to IMPORTANT INSTRUCTIONS TO USER and SERVICE REQUIREMENTS which follow.

IMPORTANT INSTRUCTIONS TO USER

Your Racal-Milgo Information Systems, Inc. Modem 24 LSI MARK II (4404-24A models listed in the Reference Data Table in this paragraph) has been approved by the Federal Communications Commission (FCC) as not being harmful to the telephone network when connected directly to the telephone lines. In order to fully comply with the Rules of the FCC, the following instructions should be read carefully and followed completely where applicable:

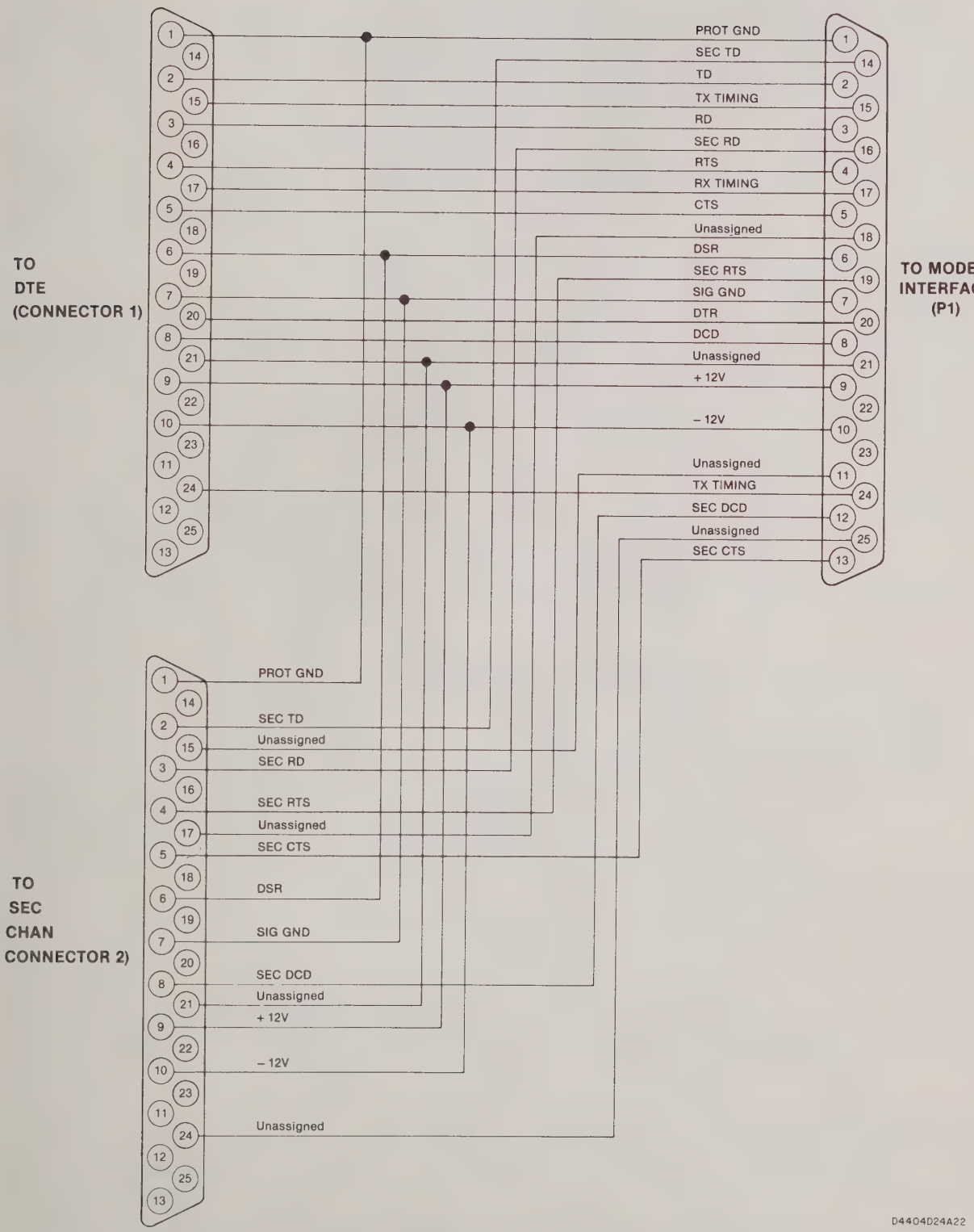


Figure 3-8: Splitting Adapter, Part No. 4402K96A, Wiring Diagram

(1) The FCC Rules require that all direct connection to the telephone lines must be made through standard plugs and jacks as called out in the Rules. No connection can be made to party lines or coin lines. Prior to connecting your device to the lines, you must:

(a) Call your local telephone company and inform them that you have an FCC Registered Connecting Device which you wish to connect to their lines. Give them the 14-digit FCC Registration Number and Ringer Equivalence, both of which are on the label located on the rear panel of your modem. These numbers are also shown in the table below.

(b) Inform your local telephone company of the jack (connector) required for your modem. The appropriate jacks are listed by Universal Service Order Code (USOC) in the table below.

REFERENCE DATA

Model No.	Registration No.	Ringer Equivalence	Jack USOC
4404-24A-91 4404-24A-92 4404-24A-93	AP3940-70032-DM-N	1.2B	RJ41S or RJ45S
4404-24A-95 4404-24A-96 4404-24A-97	AP3940-70031-DM-N	1.2B	RJ41S RJ45S or RJ11C

(c) After the telephone company has installed the appropriate jack from the table above, you can connect your registered modem by inserting into the jack the mating plug that comes with the modem.

(d) Operation of your modem is described in Section 4.

(2) If it appears that your modem may be malfunctioning it should be disconnected from the telephone line until it can be determined whether your equipment or the telephone line is the source of the trouble. If your equipment needs repairs, it must not be reconnected until such repairs are made.

(3) There is no reason why your modem should ever harm the network. If such harm does occur, the telephone company shall, where practical, notify you, the customer, that temporary discontinuance of service may be required; however, where prior notice is not practicable, the telephone company may temporarily discontinue service forthwith, if such action is reasonable under the circum-

stances. In case of such temporary discontinuance, the telephone company shall (1) promptly notify you of such temporary discontinuance; (2) afford you the opportunity to correct the situation which gave rise to the temporary discontinuance, and (3) inform you of your right to bring a complaint to the Commission, pursuant to the procedures set forth in the Rules.

Procedures for filing such complaints can be obtained from your local dealer or, if necessary, by writing directly to the manufacturer.

(4) The telephone company may make changes in its communications facilities, equipment, operations or procedures, where such action is reasonably required in the operation of its business and is not inconsistent with the Rules and Regulations of the FCC. If such changes can be reasonably expected to render any customer's terminal equipment incompatible with the telephone company communications facilities, or require modification or alteration of such terminal equipment, or otherwise materially affect its use or performance, you shall be given adequate notice in writing to allow you an opportunity to maintain uninterrupted service.

(5) You must notify your local telephone company upon final disconnection of this equipment from the telephone lines.

SERVICE REQUIREMENTS

In the event of equipment malfunction, all repairs will be performed by Racal-Milgo Information Systems, Inc., or an authorized agent of Racal-Milgo Information Systems, Inc.

This equipment has been registered with the FCC for direct connection to the telephone network. Under the FCC Program, no customer is authorized to repair this equipment, whether the equipment is in or out of warranty. If such unauthorized repair is performed, the registration of the equipment for direct connection to the network will be null and void. If the equipment is still in warranty, the remainder of the warranty period will also be null and void.

It is the responsibility of users requiring service to report the need for service to the nearest Racal-Milgo, Inc. Customer Support Office.

CUSTOMER SUPPORT OFFICES

NORTHEAST
200 Craig Road
Freehold, New Jersey 07728
(201) 780-4900 TWX: 710-722-3814

SOUTHEAST
Airport 285 Office Park Bldg. 3, Suite 102
Atlanta, Georgia 30344
(404) 763-0370 TWX: 810-751-3153

MIDWEST
1325 Remington Road, Suite I
Schaumburg, Illinois 60195
(312) 882-8720 TWX: 910-651-0008

WEST COAST
16632 Gemini Lane, Building K
Huntington Beach, California 92647
(714) 847-4422 TWX: 910-596-2613

SOUTHWEST
1301 N. Plano Road, Suite 101
Richardson, Texas 75081
(214) 238-0494 TWX: 910-867-4727

NATIONAL SUPPORT
8600 N.W. 41st Street
Miami, Florida 33166
(305) 592-8600 TWX: 810-848-6588

In the event that equipment must be returned for repair, as determined by Racal-Milgo Information Systems, Inc. Customer Support Field Engineers, or an authorized agent, instructions for return of equipment will be furnished by the Customer Support Office, or the authorized agent.

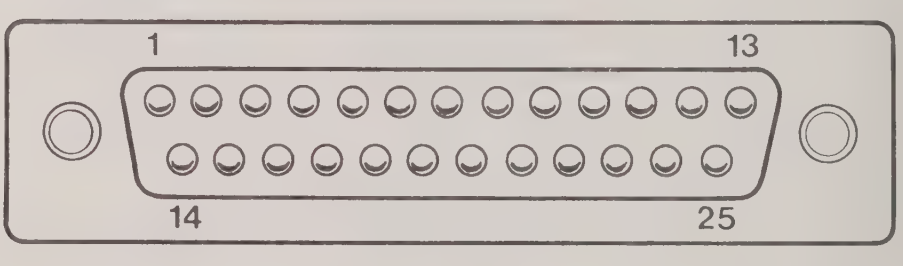
TELEPHONE SET CONNECTIONS

Telephone handsets for most applications are available from the telephone company. The Racal-Milgo, Inc. Model 502 Adapterphone is also available for certain applications. For additional information on how to order telephone sets for your application, contact your Racal-Milgo Sales Representative.

AUTO LINE ADAPTER CONNECTIONS

The function of the Model 121 Auto Line Adapter (ALA) is to switch the 4-wire lines connected to a modem from private line service to dial back up service; the switching operation is performed by the ALA in manual mode or automatic mode. However, for ALA automatic mode, the associated modem must be equipped with the Multipoint Test and Control (T7) option which normally operates with System 185 NDC or System 200 NDC.

The ALA is connected to Feature A + T7 modem at receptacle AUX J2 at the rear of the modem (Figure 3-6). AUX J2 is the 25-pin male receptacle shown in Figure 3-9. Pin/Signal Assignments are described in Table 3-2.



25 - Pin Male Connector, Pin Numbering Convention

Figure 3-9: AUX Receptacle J2, ALA Interface

Figure 3-10 shows the ALA connections to the modem and to the private and dial backup line service in 4-wire, full duplex. The dial backup send pair and receive pair from the ALA are individually connected to a Racal-Milgo, Inc. Registered Connecting Device (RCD) provided with modular line cord that plugs into the Data Jack installed by the telephone company.

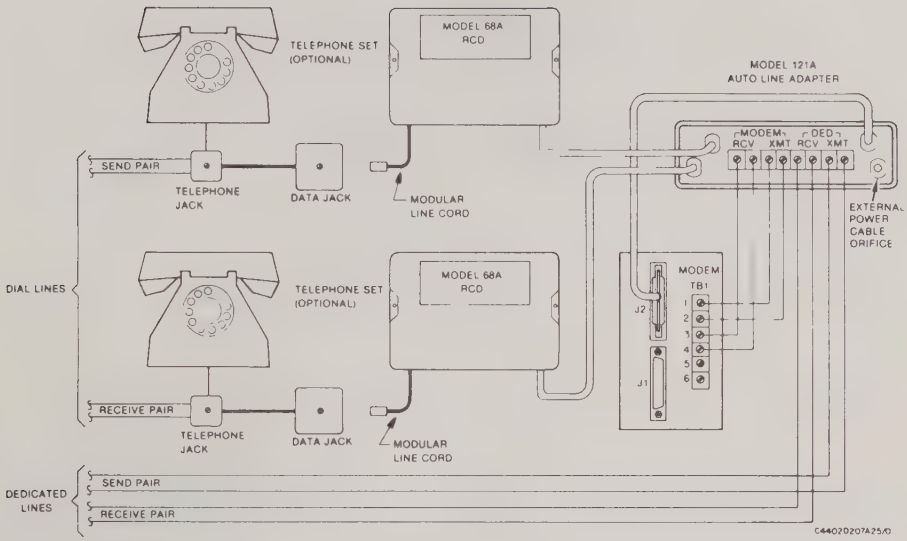


Figure 3-10: Four-Wire Private/Dial-Up Line Switching, ALA Connections

Refer to Racal-Milgo, Inc. Instruction Manual, Model 68 Registered Connecting Devices, Part No. 4402D207A1, for detailed information on RCDs. These devices are manufactured, installed and maintained by Racal-Milgo Information Systems, Inc. in accordance with Federal Communications Commission (FCC) Rules, Part 68.

FEATURE A+J2 MODEM, OPTIONAL EQUIPMENT CONNECTIONS

Feature A + J2 modems are equipped to operate with a Model 16 Voice Adapter, Model 160 Multipoint Tester with cable 4402-601E, or Model 121 Auto Line Adapter (ALA) without the facilities of the Monitor Test and Control (T7) function. Either of these three devices can be connected to AUX J2 receptacle in a Feature A + J2 modem. Table 3-3 describes the J2 pin/signal assignments for a Feature A + J2 modem.

POWER CONNECTION

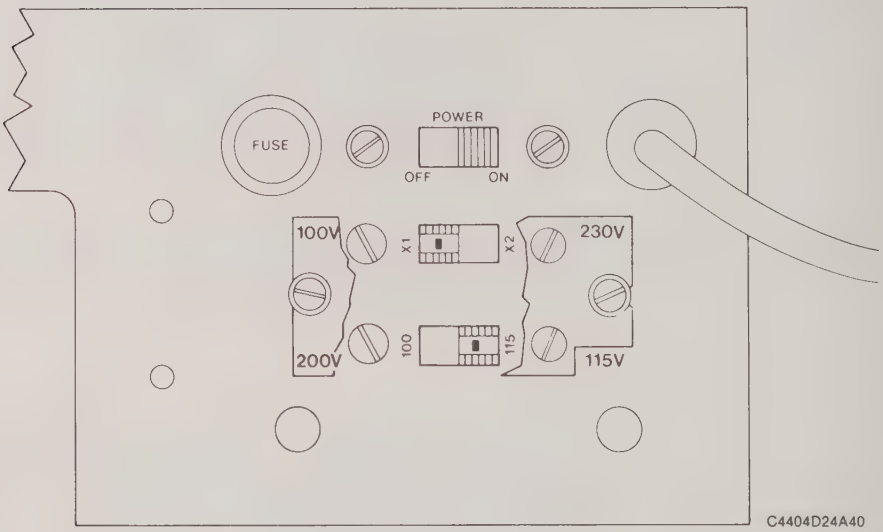
Before plugging the modem ac power connector into the ac power outlet, set the POWER ON/OFF switch to OFF.

Modems equipped with power supply, Part No. 4404-24AD-1, for domestic (USA) applications, do not require any setting for connection to the 105-125 Vac, 60 Hz ac power source.

Modems equipped with power supply, Part No. 4404-24AJ-1, for foreign country applications, have two voltage select switches on the rear panel

(Figure 3-11). Remove the cover plate protecting the switches and set the switches (X1/X2 and 100/115) for modem operation at the available ac power source. Proceed as follows:

AC Power Source	100/115 Switch	X1/X2 Switch
100 Vac	Set to 100	Set to X1
115 Vac	Set to 115	Set to X1
200 Vac	Set to 100	Set to X2
230 Vac	Set to 115	Set to X2



NOTE: In this illustration, voltage select switches and cover plate are set for 115 Vac.

Figure 3-11: Rear Panel Appearance, Modems with Power Supply Part No. 4404-24AJ-1.

Replace the cover plate so that the corner cutout on the plate coincides with the selected ac power source, as labelled on the rear panel (Figure 3-11).

The power cord supplied with the modem is UL approved, and has a 3-prong connector for standard USA 115 Vac (nominal) power outlet. In foreign country installations, the 3-prong connector may have to be replaced with another connector which meets local requirements.

PREOPERATION CHECKS

When modem installation is complete, perform the following checks before connecting the modem(s) to the ac power outlet.

(1) Strapping locations must be checked for accuracy and for firm connection of strap jumpers over strap pins.

(2) DTE cable connector must be firmly seated on receptacle J1 and secured with the screws on the connector.

(3) Feature D + R1 and D + R2 modems require a modular cord whose spade lug terminals must be connected to the terminal board. However, terminal connections of the cord must be made by an authorized Racal-Milgo, Inc. representative.

(4) Check that all pushbuttons on the front panel of the modem are in the released, "Out" position.

CONFIDENCE TESTS

After the installation of a modem or modems has been completed and verified, each newly installed modem is self tested first. Next, two distant modems are connected in an End-to-End configuration for system test.

ERROR COUNT

Self tests and system tests employ the modem built-in test generator and comparator to provide a visual error count at the ER indicator. The error count denotes the operating quality of the end modems and the transmission line.

For an "error free" condition, one error is allowed for every 100,000 bits of data. Due to the fast data bit rate of 2400 bits per second, one flash of the ER indicator may denote up to three errors. Therefore, 2400 bps for three minutes equals 432,000 bits, for which a maximum of two ER flashes is allowed.

MODEM SELF TEST

This test electronically disconnects an installed modem from the DTE and transmission lines; therefore, modems must be fully installed before initialing modem self test.

NOTE

Self Test does not apply to Feature D + R1 and D + R2 modems.

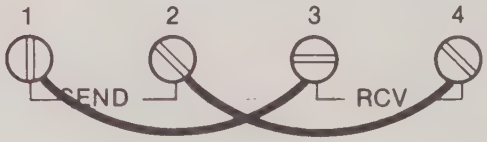
Proceed with Self Test as follows:

(1) Plug the modular power cord into the ac outlet and turn power on. The PWR indicator should light.

(2) Depress the ET and AL pushbuttons. The TST indicator should light. In this condition, the modem is in self test. The ET pushbutton activates the test pattern generator and comparator, and the AL pushbutton allows the test pattern to circulate through the modulator (transmitter) and the demodulator (receiver) of the modem.

Except for an initial flash, the ER indicator should not light at all in modem self test. Since the test pattern travel is restricted to internal modem circuits, no allowance should be made for error.

(3) Release the AL pushbutton, and place two wire jumpers at TB1 on the rear panel, thus:



NOTE

Do not jumper any terminals to which a modular telephone cord is connected. This test does not apply to Feature D + R1 and D + R2 modems.

These jumpers extend the analog loop (AL) to include the transmission line interface. The ER indicator should not light when the extended analog loop is installed.

If the ER indicator lights during the first or second portion of self test, the modem is considered defective and should be replaced. Remove the jumpers before proceeding to system test.

SYSTEM TEST

When each of the modems in the network has successfully passed the self test, a system End-to-End test between two modem sites is conducted. This test applies to 4-wire installations only.

In a multidrop network only the central site modem and one remote site modem should be connected to ac power for system test. All other remote modems should be disconnected from ac power, but left connected to the transmission lines.

Proceed with End-to-End system test as follows:

(1) Use voice communication to agree with a remote site operator to go on a system test. Request the operator to depress only the ET pushbutton. This causes the test pattern to be transmitted by the far-end modem.

(2) At the local modem, check that the DCD indicator lights. This denotes that the test pattern carrier signal from the far-end modem is being received.

(3) At the local modem, depress the ET pushbutton. Now, local and end modems are in End-to-End system test.

(4) At the local modem, conduct the three-minute error count.

(5) If the error count exceeds the allowable amount, refer to strap adjustments described in TRANSMISSION LINE CONSIDERATIONS.

(6) At the local modem temporarily release the ET pushbutton to ensure that the DCD indicator lights. Depress the ET pushbutton.

(7) Ensure that a minimum error count is reached when strap adjustments are made in the following order:

(a) RTS-CTS Delay

(b) Transmitter Timing

(c) RX Preamplifier Gain

(8) Use voice communication to request the modem operator at the far end to perform strap checks and adjustments as indicated in steps (2) through (7) of this paragraph.

Table 3-1: Receptacle J1 (DTE) Pin/Signal Assignments

PIN NO.	CCITT V.24 SYMBOL	RS232 SYMBOL	INPUT/ OUTPUT	FUNCTION
1	101	AA	—	Protective ground. Provides common for chassis and ac power.
2	103	BA	Input	Transmitted data. Serial binary signals from the DTE.
3	104	BB	Output	Received data. Serial binary signals to the DTE.
4	105	CA	Input	Request to Send (RTS). An ON condition indicates DTE is ready to send primary channel data.
5	106	CB	Output	Clear to Send (CTS). Indicates the modem is ready to transmit primary channel data.
6	107	CC	Output	Data Set Ready (DSR). Indicates that power is ON and that the modem is in normal operation, ready to transmit and receive data.
7	102	AB	—	Signal ground. Common ground reference for all circuits, except protective ground.
8	109	CF	Output	Received Line Signal (Data Carrier Detector - DCD). An ON condition indicates modem is receiving carrier signal from remote modem.
9	—	—	Output	Test + V. + 12 Vdc for modem testing.
10	—	—	Output	Test – V. – 12 Vdc for modem testing.
11 or 14	—	—	Input	New Sync. An ON condition for more than 0.4 ms simulates loss of carrier. Used only on special polling networks.
12	122	SCF	Output	Secondary Channel Received Signal. An ON condition indicates carrier received. (Available only with Feature A + S2).
13	121	SCB	Output	Secondary Channel CTS. An ON condition indicates modem is ready to transmit secondary channel data. (Available only with Feature A + S2).
14	118	SBA	Input	Secondary Channel Transmitted Data. (Available only with Feature A + S2).

Table 3-1: Receptacle J1 (DTE) Pin/Signal Assignments (Continued)

PIN NO.	CCITT V.24 SYMBOL	RS232 SYMBOL	INPUT/ OUTPUT	FUNCTION
15	114	DB	Output	Transmitted Signal Element Timing. Provides DTE with signal element timing information. (Not used with DA, see pin 24).
16	119	SBB	Output	Secondary Channel Received Data. (Available only with Feature A + S2).
17	115	DD	Output	Receiver Signal Element Timing sent to the DTE.
18	—	—	—	Unassigned.
19	120	SCA	Input	Secondary Channel RTS. An ON condition indicates that the DTE is ready to transfer secondary channel data. (Available only with Feature A + S2).
20	108/2	CD	Input	Data Terminal Ready (DTR). An ON condition prepares the modem to be connected to the telephone dial-up line. An OFF condition disconnects the modem from the dial-up telephone lines. (Available only with Feature D + R1, D + R2 and D + L2.)
21	—	—	—	Unassigned.
22	125	CE	Output	Ring Indicator. Indicates that modem location has been called. (Available only with Feature D + R1, D + R2 and D + L2).
23	—	—	—	Unassigned.
24	113	DA	Input	Transmitter Signal Element Timing. Provides modem with signal element timing information from DTE. (Not used with DB, see pin 15).
25	—	—	—	Unassigned.

Table 3-2: AUX Receptacle J2 in Feature A + T7 Modems, Pin/Signal Assignments

PIN NO.	SIGNAL NAME	INPUT/ OUTPUT	FUNCTION
1	Protective Ground	—	Electrical and ac ground line.
2	—	—	Unassigned.
3	CONT 4	Input	Undefined input.
4	DTR	Output	An ON condition indicates that DTE is ready for data exchange.
5	CONT 3	Output	Undefined output.
6	DED/ $\overline{\text{DIAL}}$	Output	An ON (low level) condition indicates to ALA to switch modem line from dedicated to dial-up.
7	Signal Ground	—	Common ground reference potential for all circuits, except protective ground.
8	$\overline{\text{DISC}}$ $\overline{\text{DIAL}}$	Output	An ON (low level) condition indicates to ALA to disconnect the dial-up line.
9	$\overline{\text{DCD}}$	Output	An ON (low level) condition indicates to ALA that the modem is receiving a data carrier signal.
10	ADBU READY	Input	An ON condition from ALA indicates that modem is connected to the dial-up line.
11	+ 12V	Output	+ 12V power for ALA.
12	– 12V	Output	– 12V power for ALA.
13	—	—	Unassigned.
14	CONT 1	Output	Undefined Output.
15	RX PREAMP Signal	Output	Received line signal from modem receiver preamplifier.
16	$\overline{\text{4W}}$	Input	External 2-wire/4-wire control.
17	CONT 2	Output	Undefined Output.
18-21	—	—	Unassigned.
22	RI	Input	An ON condition indicates that modem site has been called.
23-25	—	—	Unassigned.

Table 3-3: AUX Receptacle J2 in Feature A + J2 Modems, Pin/Signal Assignments

PIN NO.	SIGNAL NAME	INPUT/ OUTPUT	FUNCTION	OPTIONAL EQUIPMENT
1	Protective Ground	—	Electrical and ac ground line.	All
2-3	—	—	Unassigned.	—
4	DTR	Output	An ON condition indicates that DTE is ready for data exchange.	ALA
5-6	—	—	Unassigned.	—
7	Signal Ground	—	Common ground reference potential for all circuits, except protective ground.	All
8	—	—	Unassigned.	—
9	$\overline{\text{DCD}}$	Output	An ON (low level) condition indicates to ALA that the modem is receiving a data carrier signal.	ALA
10	—	—	Unassigned.	—
11	+ 12V	Output	+ 12V power for optional equipment.	All
12	– 12	Output	– 12V power for optional equipment.	All
13	$\overline{\text{Disable}}$	Input	Open = + 5V = modem activated for normal data exchanges. Grounded = OV = modem disabled for data exchanges, but can handle voice communications. When modem is disabled, the DSR signal to the DTE is turned off and the TST indicator turns on.	VA
14	—	—	Unassigned.	—
15	RX PREAMP Signal	Output	RX signal for Voice Adapter.	VA, ALA
16	$\overline{\text{4W}}$	—	External 2-wire/4-wire control.	—
17	—	—	Unassigned.	—
18	Sec. TX Signal	Input	TX signal for Voice Adapter.	VA
19-24	—	—	Unassigned.	—
25	+ 5V	Output	Direct connection to + 5V power.	—

Table 3-4: Receptacle J2 (Feature D + L2), Pin/Signal Assignments

PIN NO.	SIGNAL NAME	INPUT/ OUTPUT	FUNCTION
1	Protective Ground	—	Electrical and ac ground line.
2 3	DT DR	Input Input	These two terminals are the 2-wire telephone connection to the RCD.
4	DTR	Output	Data Terminal Ready signal.
5	CCT	Input	Coupler Cut Through from RCD.
6	OH/DA	Output	Off Hook and Data Access signal to RCD.
7	SG	—	Signal Ground (OV).
8	DIS	Input	Disconnect signal from RCD.
9	—	—	Not Used.
10	SH	Input	Switch Hook signal from RCD.
11	+ V	Output	+ 12VDC power to RCD.
12	– V	Output	– 12VDC power to RCD.
13	$\overline{\text{Disable}}$	Input	Disable signal from accessory.
14-21	—	—	Not Used.
22	RI	Input	Ring Indicator signal from RCD.
23-24	—	—	Not Used.
25	+ 5V	Output	+ 5VDC power to accessory.

Table 3-5: Receptacle J3-TER (Feature S7), Pin/Signal Assignments

PIN NO.	SIGNAL NAME	INPUT/ OUTPUT	FUNCTION
1	Prot. Gnd.	—	Protective Ground. Provides common for chassis and ac power.
2	TTD	Input	S7 Tertiary Channel Transmitted Data.
3	TRD	Output	S7 Tertiary Channel Received Data.
4	TRTS	Input	S7 Tertiary Channel Request Send.
5	TCTS	Output	S7 Tertiary Channel Clear to Send.
6	TDSR	Output	S7 Tertiary Channel Data Set Ready. This lead is always held in a positive/on state.
7	Sig. Gnd.	—	Signal Ground. Common ground reference for all circuits except protective ground.
8	TDCD	Output	S7 Tertiary Channel Data Carrier Detector.
9	+ V	Output	+ 12V Testing Voltage.
10	– V	Output	– 12V Testing Voltage.
11-25	—	—	Not Used.

Table 3-6: J2-AUX (Feature S7 + T7), Pin/Signal Assignments

PIN NO.	SIGNAL NAME	INPUT/ OUTPUT	FUNCTION
1	Prot. Gnd.	—	Protective/Chassis Ground.
2	$\overline{\text{Cust. Alarm}}$	Input	Customer Alarm Mayday Input.
3	Cont. 4	Input	Control Bit Data Into T7.
4	TCTS	Output	Tertiary Clear to Send.
5	Cont. 3	Output	Control Bit Load Control from T7.
6	DED/ $\overline{\text{DIAL}}$	Output	Indication to ALA to switch the modem between dedicated and dial lines.
7	Sig. Gnd.	—	Signal Ground.
8	$\overline{\text{DISC}}$/ $\overline{\text{DIAL}}$	Output	Indication to ALA to Disconnect Dial Line.
9	$\overline{\text{DCD}}$	Output	Indicates Primary Channel Carrier present ALA use.
10	DBU RDY	Input	Indicates ALA connected to Dial Line.
11	+ 12VDC	Output	Power for Accessory.
12	– 12VDC	Output	Power for Accessory.
13	—	—	Not Used.
14	Cont. 1	Output	Control Bit Data from T7.
15	Rx Preamp Signal	Output	Received Line Signal from modem preamplifier.
16	$\overline{\text{4W}}$	Input	External 2W/4W Control. NOT USED.
17	Cont. 2	Output	Control Bit Clock from T7.
18	—	—	Not Used.
19	TRTS	Input	Tertiary Request to Send.
20	TTD	Input	Tertiary Transmit Data.
21	TRD	Output	Tertiary Receive Data.
22	TDCD	Output	Tertiary Data Carrier Detect.
23	—	—	Not Used.
24	—	—	Not Used.
25	+ 5V	Output	Power for Accessory.

Table 3-7: J2-AUX (Feature S7 + S2), Pin/Signal Assignments

PIN NO.	SIGNAL NAME	INPUT/ OUTPUT	FUNCTION
1	Prot. Gnd.	—	Protective/Chassis Ground.
2	—	—	Not Used.
3	—	—	Not Used.
4	TCTS	Output	Tertiary Clear to Send.
5	—	—	Not Used.
6	—	—	Not Used.
7	Sig. Gnd.	—	Signal Ground.
8	—	—	Not Used.
9	$\overline{\text{DCD}}$	Output	Indicates Primary Channel Carrier present. ALA use.
10	—	—	Not Used.
11	+ 12VDC	Output	Power for Accessory.
12	– 12VDC	Output	Power for Accessory.
13	—	—	Not Used.
14	—	—	Not Used.
15	Rx Preamp Signal	Output	Received Line Signal from modem preamplifier.
16	$\overline{\text{4W}}$	Input	External 2W/4W Control. Not Used.
17	—	—	Not Used.
18	—	—	Not Used.
19	TRTS	Input	Tertiary Request to Send.
20	TTD	Input	Tertiary Transmit Data.
21	TRD	Output	Tertiary Receive Data.
22	TDCD	Output	Tertiary Data Carrier Detect.
23	—	—	Not Used.
24	—	—	Not Used.
25	+ 5V	Output	Power for Accessory.

SECTION 4

OPERATION

GENERAL INFORMATION

Instructions provided in Sections 2 and 3 must be strictly followed before proceeding to operate the 24 LSI MARK II.

Before applying power, verify that DTE, transmission lines, optional equipment, if any, and ac power connectors are correctly placed and firmly attached to their receptacles and terminals. Verify that strap plugs are correctly placed and firmly seated on the PC card locations.

MANUAL CONTROLS AND INDICATORS

The modem 24 LSI MARK II front panel (Frontispiece) has all the pushbutton switches and indicators required for the operation of the energized unit; the POWER ON/OFF slide switch is located on the rear panel.

Pushbutton switches are depressed to the locked, "In" position, and are depressed again to the released "Out" position. All indicators are of the LED (light emitting diode) type. Refer to Table 4-1 for a description of manual controls and indicators. Before operating the modem, become thoroughly familiar with the designation of all manual controls and indicators, and the function of each.

MODES OF OPERATION

Modem 24 LSI MARK II operates in one of two modes: normal, on-line mode and test mode.

NORMAL MODE

Normal Mode prevails when the modem transmits and receives synchronous data exchanges with the customer terminal equipment (DTE). These exchanges occur on a primary channel at a data rate of 2400 bps over 2-wire or 4-wire lines (Figure 4-1). The PWR and DSR indicators must light, and the TST and ER indicators must be off to denote normal operation.

Feature A + S2. A + S7, A + T1, A + T2, A + T3, and A + T7 modes have secondary channel circuits that perform asynchronous data exchanges. The secondary channel in each feature operates independently from the primary channel synchronous data.

TEST MODE

Test Mode is used to verify correct modem operation, correct telephone line operation, and check customer terminal equipment (DTE) operation. The following tests can be performed with the modem:

DL — Digital Loopback

AL — Analog Loopback

RT — Receive Test or Remote Test

ER — Error Test (511 Test Pattern)

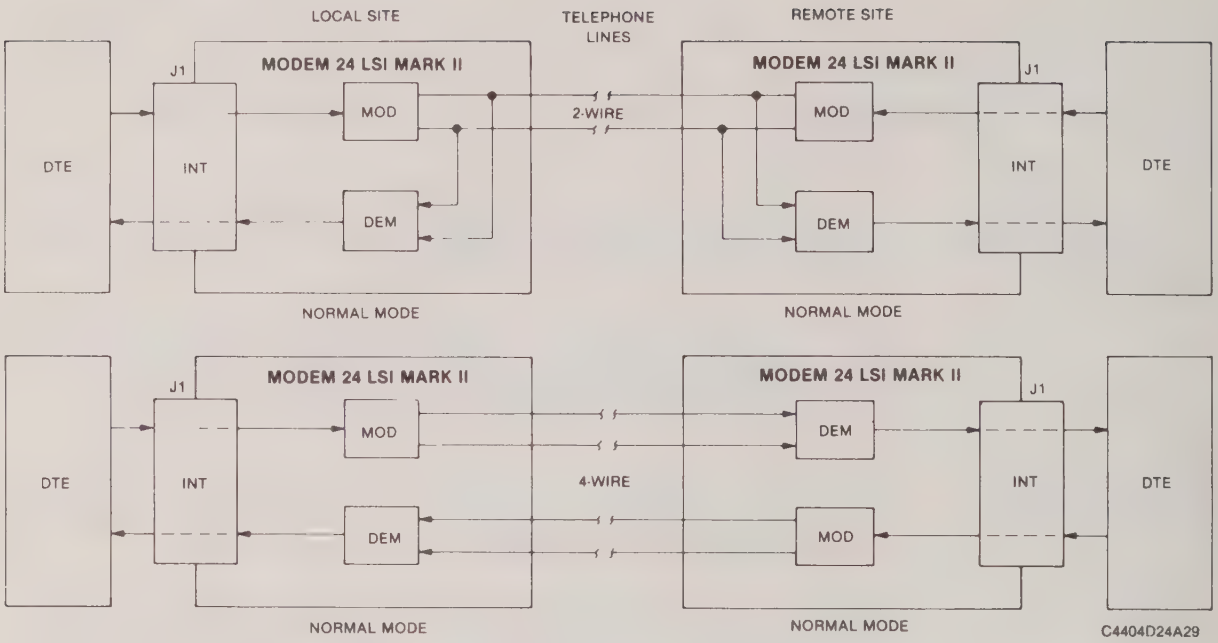


Figure 4-1: Typical Two-Wire and Four-Wire Point-to-Point System Configurations

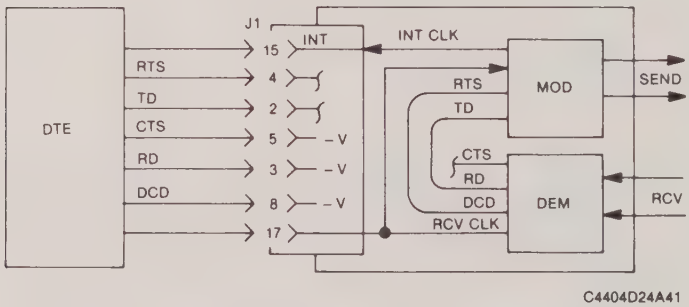


Figure 4-2: DTE/Modem Line Connections in DL Test

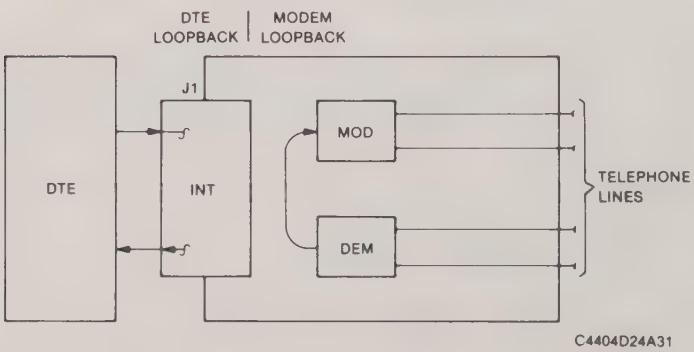


Figure 4-3: DL Test in Four-Wire Circuits

Any of these tests may be manually activated by depressing the corresponding pushbutton switch on the modem front panel. When the DL, AL, RT, or ET pushbutton is depressed, the TST indicator lights to denote that the modem is in test mode. Tests initiated by pushbutton operation perform as follows:

(1) **DL Test** - Figure 4-2 shows DTE/modem line connections during DL test. The modem interface does not provide a loop for DTE data. However, in 4-wire circuits (Figure 4-3), the demodulator output is looped to the modulator input, so that the local modem may be tested by a remote modem.

(2) **AL Test** - Figures 4-4 and 4-5. The DTE may test the modem modulator and demodulator circuits. Also, in 4-wire networks, the local modem loops back the telephone lines, so that the remote modem may test the telephone lines. In 2-wire networks, no line loopback is possible.

(3) **Receive Test** - (See Table 2-1, RT SWITCH-RCV strap.) The RT pushbutton switch with the Receive Test function causes the modem transmitter output to be disabled, so that modem operation is restricted to telephone line signal reception only. Figure 4-6 shows End-to-End System Test in 2-wire circuits using RT (receive test) and ET (error test) facilities.

(4) **Remote Test** - (See Table 2-1, RT SWITCH-REM Strap.) The RT pushbutton with the Remote Test function applies to the two Feature A + T1 modems in a 4-wire point-to-point network, where one modem can force the other modem to go into DL or AL test.

(5) **Error Test** - The modem inhibits signal exchanges with the DTE; instead, the modem connects the test pattern generator and comparator to the modulator and the demodulator, respectively. Figure 4-7 shows the modem isolated for Self Test when the ER and AL pushbuttons are both depressed. In Self Test, correct modem operation is denoted by the ER (Error) indicator always remaining off. Figure 4-8 shows End-to-End System Test configuration using the ET facilties.

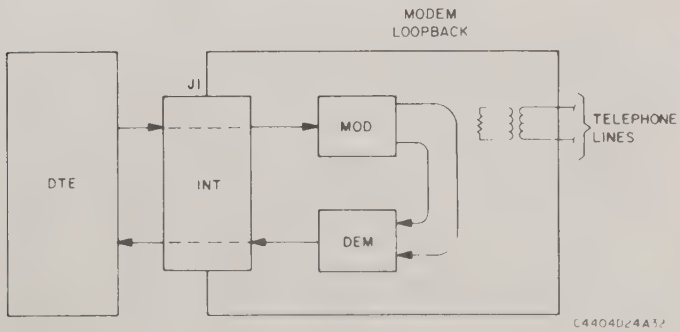


Figure 4-4: AL Test in Two-Wire Circuits

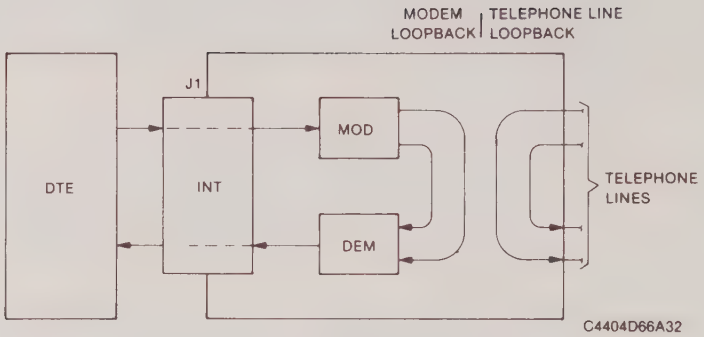


Figure 4-5: AL Test in Four-Wire Circuits

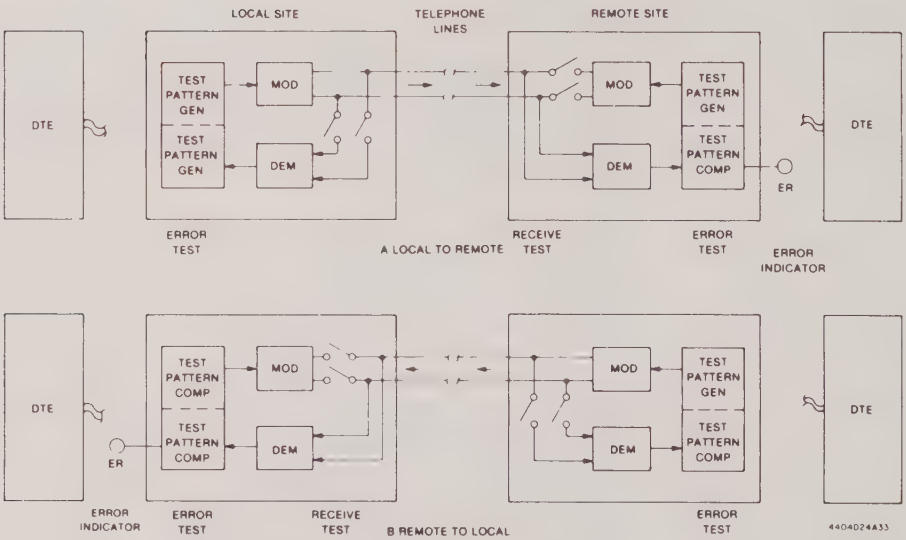


Figure 4-6: Two-Wire End-to-End System Test Using Error Test and Receive Test Facilities

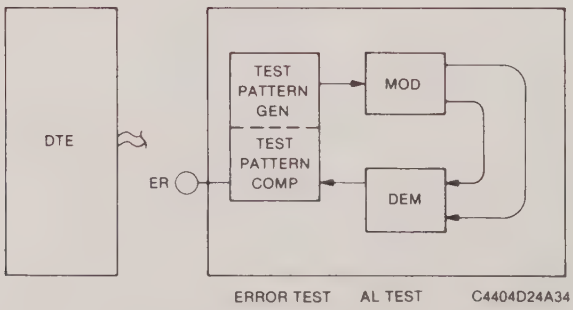


Figure 4-7: Modem Self Test

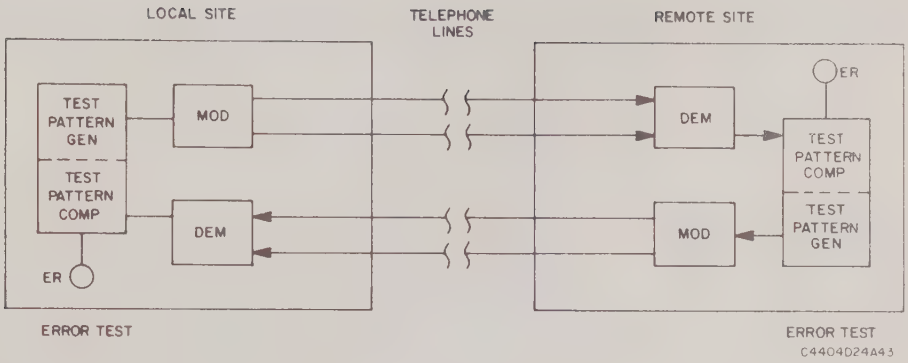


Figure 4-8: Four-Wire End-to-End System Test Using Error Test Facilities

ON-LINE OPERATION IN PRIVATE LINE NETWORKS

To initiate data exchange in private line network, proceed as follows:

(1) Check that the modem is set for normal, on-line operation; all pushbuttons (DL, AL, RT, ET) must be in the released, "Out" position.

(2) Set the POWER ON/OFF switch to ON. The PWR indicator should light, the TST indicator should be extinguished, and the DSR indicator should light.

(3) At this point, the modem is ready to send and receive data.

Voice communication over private lines requires a Feature A + J2 modem equipped with a Model 16 Voice Adapter. For voice communication, operate the voice adapter as follows:

A. Call Origination

(1) Lift the handset.

(2) Momentarily depress the VOICE pushbutton.

(3) Depress the RING pushbutton for five seconds. The RI indicator in the voice adapter should flash as the ringing signal is transmitted to the other end.

(4) After the RING pushbutton is released, the voice mode prevails until the handset is replaced on its cradle.

B. Call Answering

(1) When the audible tone is heard, lift the handset and momentarily depress the VOICE pushbutton.

(2) Conduct voice exchange.

(3) When voice exchange terminates, replace the handset on its cradle. This action switches modem and voice adapter from voice mode to data mode.

(4) Resume data exchanges.

ON-LINE OPERATION IN REPEATER MODE

Long distance, private line communication between two modem sites can be subject to considerable signal quality degradation and attenuation. To reduce these conditions, repeater modems are occasionally installed midway between the two end sites. Figure 4-9 shows a long distance communications link using two Modems 24 LSI MARK II connected back-to-back (J1 to J1) as repeater modems. Signal wiring for the cable connecting the two modems is also shown in Figure 4-9.

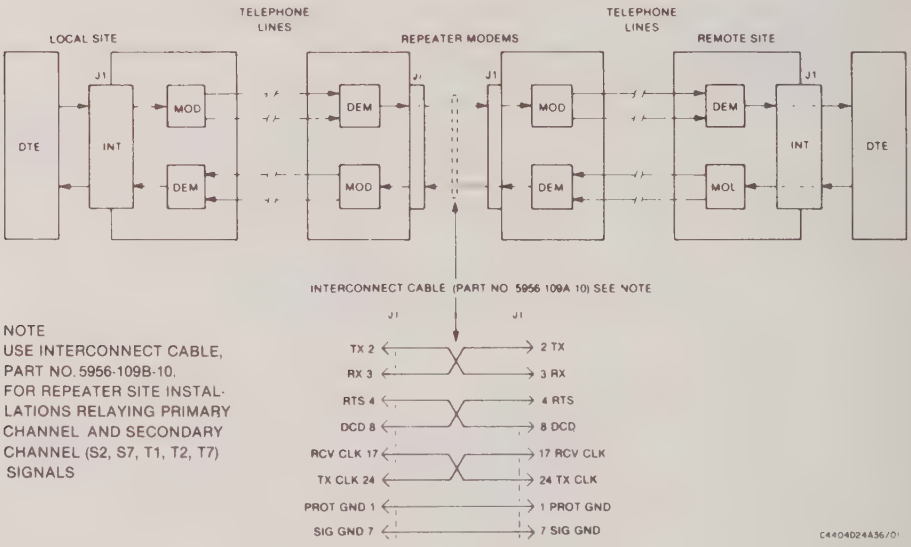


Figure 4-9: Private Line Network with Repeater Site

ON-LINE OPERATION IN DIAL-UP LINE NETWORK

Feature D + R1 and D + R2 modems can be strapped for manual or automatic answer operation on dial-up lines (Table 2-5, AUTO ANS/OUT/IN strap). However, the telephone set (USOC-RTC) associated with these modems is installed by the telephone company in accordance with four options which determine the procedures to use dial-up line service.

The options are:

(1) USOC-RTC OPTION A1 - Telephone Set Controls the line.

(2) USOC-RTC OPTION A2 - Data Set (Modem) Controls the line.

(3) USOC-RTC Option B3 - No Aural Monitoring

(4) USOC-RTC Option B4 - Aural Monitoring.

(5) USOC-RTC Option C5 - Touch Tone®

(6) USOC-RTC Option C6 - Rotary dial

(7) USOC-RTC Option D7 - Switchhook indication only. With this option the modem is notified only that the handset has been lifted from the cradle. This option is not for data use.

(8) USOC-RTC Option D8 - With this option the modem sees a closed circuit when the phone is in voice mode; this circuit opens when the phone goes to data mode. This option required for data use.

USOC-RTC Option A1 - Telephone Set Controls the Line, Dial-up Line Procedures.

A. Manual Originate and Manual Answer.

(1) For voice communication, lift handset without pulling up exclusion key. Dial call or answer call.

(2) For data exchange, pull up exclusion key and rest handset upon a surface next to the telephone set.

(3) At the end of data exchange, automatic line disconnect occurs, either by the DTR signal dropping, or by line current status indication (LCSI).

(4) The line may be disconnected at any time by depressing the DL pushbutton on the modem front panel.

(5) If the telephone handset is allowed to remain off hook and the exclusion key pulled up, the modem will answer calls automatically, and will initiate data exchange.

(6) Whenever the handset is placed on hook, the modem is disconnected from the line.

B. Setting up for Auto Answer.

(1) Assuming that the telephone handset is on hook, make sure that the DTR signal is down and/or the DL pushbutton is depressed.

(2) When step (1) is executed, lift the handset and rest it upon a surface next to the telephone set.

(3) Pull up the exclusion key.

(4) Turn on the DTR signal and/or release the DL pushbutton.

(5) The modem is now ready to answer calls automatically and to conduct data exchanges.

(6) If necessary, any data exchange may be manually terminated by depressing the DL pushbutton or placing the telephone handset on hook.

USOC-RTC Option A2 - Data Set Controls the Line, Dial-up Line Procedures.

Manual Originate - Manual Answer - Automatic Answer

(1) For voice communication, lift handset and pull up exclusion key. Dial or answer call.

(2) For data exchanges, place the exclusion key in the middle position. Placing the handset on hook during Aural Monitoring (USOC-RTC Option B4) disconnects the telephone set from the telephone line, but still allows data exchanges to occur.

(3) For automatic answering applications, always leave the handset on hook. The modem will answer calls automatically (if so strapped), and will initiate data exchanges by itself.

(4) At the end of each exchange, automatic line disconnect occurs either by the DTR signal dropping off, or by line current status indication (LSCI). The handset remains on hook during automatic disconnect.

(5) If necessary, any data exchange may be terminated by depressing the DL pushbutton.

OPERATION WITH FEATURE A+S2 SECONDARY CHANNEL

The Secondary Channel operates on 4-wire, full duplex, simultaneously with the primary data channel. For continuous carrier, the JW15 jumper in the Secondary Channel PC Card (Table 2-3) must be removed. For switched carrier operation, the JW15 jumper must be installed, and the required secondary RTS signal must be provided by the DTE (single cable or splitting adapter) at connector J1, pin 19. RTS to CTS delay is 120 ms ± 20 ms in continuous or switched carrier.

For transmission the FSK modulated center frequency is 419 Hz. The MARK 392 Hz tone and SPACE 447 Hz tone cannot be reversed. Data Speed rate is 150 bps.

The Secondary Channel is enabled to transmit and receive independently of the DL, AL, RT, and ET tests which may affect primary channel operation.

OPERATION WITH FEATURE A+S7 TERTIARY CHANNEL

The Tertiary Channel is used for four-wire full or half-duplex operation. It can only be used with either the S2 or the S7 options.

It operates on the high end (3180 Hz) center frequency, and it may be used for switched or continuous carrier operation. Transmission and reception are independent of the ET, RT, AL, and DL tests of the modem's primary channel.

TEST OPERATION WITH FEATURE A+T1 POINT-TO-POINT TEST

Feature A + T1 is enabled by strapping the Main PC Card (Table 2-1) to the RT SWITCH-REM position. Thus, the RT pushbutton on the modem front panel has the remote test function necessary for A + T1 operation.

When both the DL and the RT pushbuttons are depressed, the Point-to-Point Test PC Card generates a 392 Hz tone which is transmitted by the modem. This tone signal forces the far end modem to go into a digital loopback which can be used to test the receiver and transmitter at the far-end modem, as well as the telephone line. The test signal may be the 511-test pattern which is activated when the ET pushbutton is also depressed at the local modem.

When both the AL and RT pushbuttons are depressed, the Point-to-Point Test PC Card generates a 447 Hz tone which is transmitted by the modem. This tone signal forces the far end modem to go into an analog loopback which can be used to test the telephone line interface circuits of the far-end modem, as well as the telephone line. The test signal may be 511-test pattern which is activated when the ET pushbutton is also depressed at the local modem.

TEST OPERATION WITH FEATURE A+T2 CENTRAL SITE MULTIPOINT TEST

Figure 4-10 shows the logical operation of Feature A + T2 at the central site modem. The Model 160 MT connected to receptacle J2 of the modem (Figure 3-7) is the source of address and command codes sent to a Feature A + T3 remote modem in the Multidrop Network.

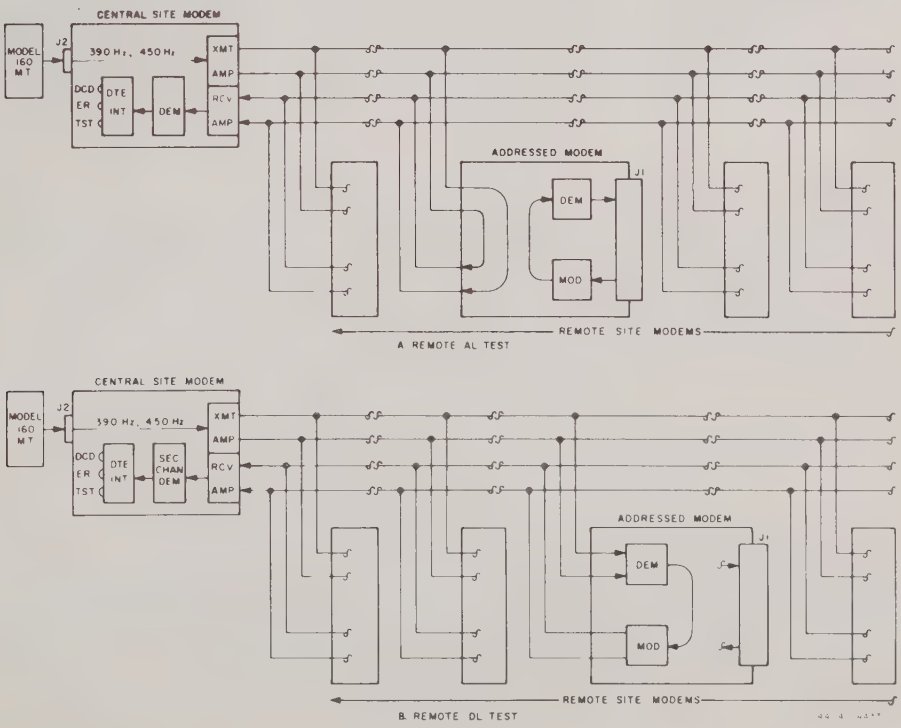


Figure 4-10: Four-Wire Multidrop System Remote Testing with Slave Feature A + T3 Modems.

Model 160 MT selects the remote modem by address code, and forces the addressed modem into digital loopback or analog loopback. The test signal may be the modem generated 511-test pattern which is activated when the ET pushbutton is depressed at the central site modem.

When a loopback test is being conducted between the central site and one remote site modem, all other remote site modems in the Multipoint Network are disabled from conducting normal data exchanges.

TEST OPERATION WITH FEATURE A+T3 REMOTE MULTIPOINT TEST

Figure 4-10 shows the logical operation of Feature A+T3 remote site modems in a Multidrop or Multipoint Network. The remote Multipoint Test PC Card contains the assigned address code and anti-streaming timer strap (Table 2-8).

The anti-streaming timer located on Feature A + T3 modem may be used in normal operation to prevent any remote site from transmitting for more than 30 seconds and, therefore, impairing the data transmission network. If RTS is raised for more than 30 seconds, the modem is disabled from transmitting or receiving any data, the DSR signal drops, and the modem's TST indicator illuminates. The lowering of RTS resets this timer. Activation of DL or ET test modes will also reset this timer. The anti-streaming timer may be strapped in or out (Table 2-8, ANTI-STREAM strap).

OPERATION WITH FEATURE A+T7 MONITOR TEST AND CONTROL

Figure 4-11 shows the logical operation of central site and remote site Feature A + T7 modems. The Multipoint Test and Control PC Card has strap settings for central site and remote site, as well as site address assignments (Table 2-2). Anti-streaming threshold strap settings (STH, STL) are also available in the PC Card; the central site modem should be strapped for the next longer streaming period than its associated remote site modems.

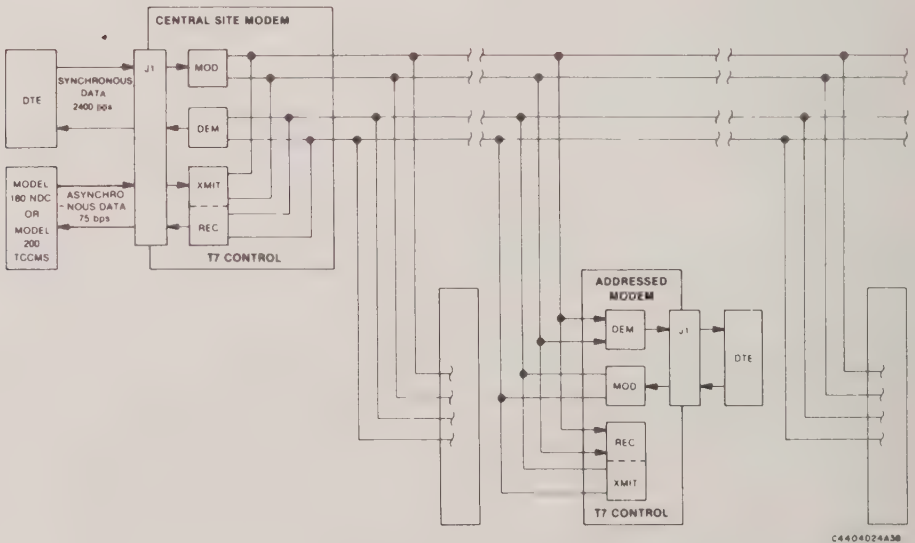


Figure 4-11: Four-Wire Multidrop System with Feature A + T7 Modems

System 185 NDC or System 200 NDC connected to J1 of the central site modem operates the secondary channel of the T7 PC Card. Through this channel, the NDC issues address and command codes to the Feature A + T7 remote site modems. The addressed modem, in addition to receiving and executing the commands may also generate Mayday Messages which are transmitted through the central site to the controlling NDC.

Mayday Messages include Customer Alarm, Streaming, Receive Line Fault, Modem Power Failure, and Dedicated Line Not Restored. With the exception of Receive Line Fault, which is transmitted on a one-shot basis for 8 to 18 seconds, all other mayday messages are transmitted continuously until terminated by NDC command.

NDC commands processed by the T7 feature fall into one of two general classes: test mode commands, or control commands. The main test mode commands are:

(1) Self Test

(2) End to End Test

(3) Analog Loopback with or without 511-test pattern

(4) Digital Loopback with or without 511-test pattern

(5) Interface Status Monitor

Self Test Mode affects the modem under test only. End-to-End, Analog Loopback and Digital Loopback interrupt all traffic in the communications line related to thd modems conducting the test. The Interface Status Monitor does not interrupt traffic.

Through the T7 control circuits, the NDC may perform line switching (dedicated to dial-up or vice versa) on central and remote site modems connected to an automatic line adapter. Refer to Instruction Manual, Racal-Milgo Part No. 4404D121A1, Model 121A Auto Line Adapter (ALA).

For ALA operation, the following control commands are issued by the NDC:

(6) Switch to Dedicated Line (SDL)

(7) Switch to Dial Back-up (SDB)

(8) Disconnect Dial Lines (DDL)

Additionally, the remote site A + T7 modem may transmit the Dedicated Line NOT Restored mayday message. This message becomes necessary during the dial to dedicated switching process when the restored dedicated line does not function properly.

Table 4-1: Manual Controls and Indicators

NAME	POSITION	FUNCTION
POWER ON/ OFF Switch	OFF	Ac line power is disconnected.
	ON	Ac line power is connected. PWR indicator should light.
DL Pushbutton	In	The modem goes into digital loopback test. In Feature A + T1 modems, when the RT (Remote Test function) pushbutton is also depressed, the far end modem is forced into digital loopback. TST indicator should light.
	Out	Digital loopback test is disabled.
AL Pushbutton	In	The modem goes into analog loopback test. In Feature A + T1 modems, when the RT (Remote Test function) pushbutton is also depressed, the far end modem is forced into analog loopback test. TST indicator should light.
	Out	Analog loopback test is disabled.
RT Pushbutton (Receive Test Function)	In	Refer to Table 5, RT SWITCH-RCV strap. RTS indicator may light under DTE control; however, the modem ignores the signal. Modem transmitter is disabled. DSR and CTS signals are inhibited. TST indicator should light.
	Out	Receive Test (receive only) is disabled.
RT Pushbutton (Remote Test Function)	In	Refer to Table 5, RT SWITCH-REM strap. In Feature A + T1 modems, when the DL or AL pushbutton is also depressed, the far end modem is forced into digital or analog loopback. TST indicator should light.
	Out	Remote Test is disabled.
ET Pushbutton (Error Test)	In	The modem is enabled to transmit and/or receive a 511-test pattern. Signals from the DTE are ignored. Signals to the DTE are inhibited. ER indicator flashes when 511-test pattern errors are received.

Table 4-1: Manual Controls and Indicators (Continued)

NAME	POSITION	FUNCTION
ET Pushbutton (Error Test) (continued)		TST indicator should light.
	Out	Error test is disabled.
RD Indicator	(Green)	Lights to indicate that Receive Data signal is present at DTE J1-3 pin.
DCD Indicator	(Green)	Lights to indicate that Data Carrier Detected signal is present at DTE J1-8 pin.
TD Indicator	(Yellow)	Lights to indicate that Transmit Data signal is present at DTE J1-2 pin.
RTS Indicator	(Yellow)	Lights to indicate that Request to Send signal is present at DTE J1-4 pin.
DSR Indicator	(Red)	Lights to indicate that Data Set Ready signal is present at DTE J1-6 pin.
DTR Indicator	(Red)	Lights to indicate that Data Terminal Ready signal is present at DTE J1-20 pin. DTR indicator will also light due to DTE cable disconnected or open lead.
ER Indicator	(Red)	Lights to indicate that the modem is receiving 511-test pattern error(s), during Error Test.
TST Indicator	(Red)	Lights to indicate that the modem is in test mode; i.e., the DL, AL, RT, or ET pushbutton is depressed. TST indicator will also light when modem is remotely forced into test mode.
PWR Indicator	(Red)	Lights to indicate that the modem circuits are energized.

SECTION 5

SYSTEM FAULT ISOLATION

GENERAL INFORMATION

Modem 24 LSI MARK II has built-in test circuits which provide loopback control and test pattern generation and comparison. These circuits are manually activated for one of two reasons: to verify modem operation during scheduled checks, or to isolate a system malfunction.

System malfunctions are commonly indicated by a high rate of errors in data received by the associated DTE; for example, excessive NAK (negative acknowledgement) count, or excessive block retransmitted count.

At times, system malfunction is indicated by "catastrophic" failure. An example would be a sudden loss of carrier signal detection (DCD). The source of a "catastrophic" failure may range from the ac power connector being accidently disconnected from the outlet, to the break of a transmission line at considerable distance from the site.

CAUTION

Under all circumstances, the DTE personnel must be notified before placing the modem in test mode. Failure to do so may result in serious disruption of data handling at the customer site.

TEST FUNCTIONS

The modem built-in test functions consist of loopback controls and test pattern generation and comparison. Loopback controls connect modem transmitter and receiver in a looped data path which may be local or may link two distant modems. The test pattern circulates through this path to exercise and check modem normal functions.

Any of the following test functions may be activated by depressing the corresponding pushbutton on the modem front panel.

ET - Error Test. Activates Test Pattern Generator and Comparator.

RT - Receive test. Inhibits modem transmission for one-way transmission line test.

AL - Analog Loopback for Local Test.

DL - Digital Loopback for Local Test.

When any of the four pushbuttons is depressed to the "In" position, the TST indicator lights and the modem is set to test mode. The ET and AL pushbuttons simultaneously depressed serve to perform local modem self test.

Table 5-1 indicates the lighted or extinguished (on or off) state of the indicators when the pushbuttons are depressed.

Test function performance is as follows:

ET - Error Test provides a scrambled zeros (0s), 511-bit test pattern which is used as simulated data in various test configurations. When the ET pushbutton is depressed, the test pattern generator and test pattern comparator circuits are activated in the modem. From the generator, the test pattern circulates through a data loop (analog or digital loop) and returns to the comparator where it is checked for accuracy. The test pattern returned with errors causes the ER indicator to light. Refer to CONFIDENCE TEST, Error Count.

RT - Receive Test. This function causes the modem modulator output to be disabled so that modem operation is restricted to signal reception only. Figure 5-1 shows End-to-End System Test in 2-wire circuits using RT (receive test) and ET (error test) facilities.

AL - Analog Loopback causes two local loop actions at the originating modem: the transmitter output is connected to the receiver input, and the receive pair line is connected to the send pair line (Figure 5-2).

DL - Digital Loopback causes two local loop actions: the receiver output is connected to the transmitter input, and the transmit data (TD) input from the DTE is connected to the receive data output to the DTE (Figure 5-3).

ET + AL - When both the ET and AL pushbuttons are depressed, the modem is in self test (Figure 5-4). In this condition, the test pattern generator and comparator are connected to an analog loop path formed by the transmitter and receiver of the modem. The DTE and transmission line interfaces are automatically disconnected; thus, the modem is isolated for self test.

ET + ET - In a point-to-point configuration, end-to-end system test is provided by depressing the ET pushbutton at both end modems (Figure 5-5). The test pattern generated at one modem is compared with the other, in a mutual, two-way exchange.

In a step-by-step test procedure, the end-to-end system serves to check transmission line performance after the two modems have been successfully self tested.

SYSTEM FAULT ISOLATION

When system malfunction occurs, start searching for the source of the problem at the most accessible portion of the network. In most cases, this will be the modem. Perform your search in a logical, progressive manner; for example:

(1) Check modem installation.

— PWR indicator on.

— Cable connectors firmly set and secured.

— Transmission lines correctly and firmly connected.

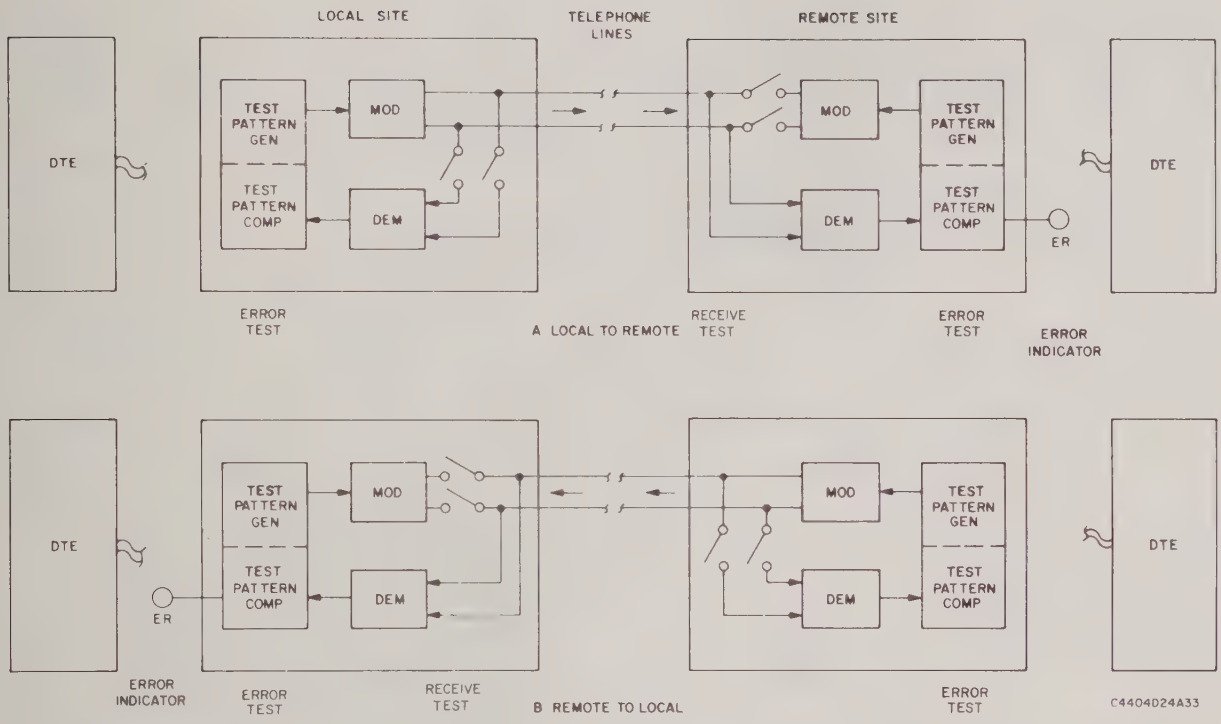


Figure 5-1: Two-Wire End-to-End System Test Using ET and RT Facilities

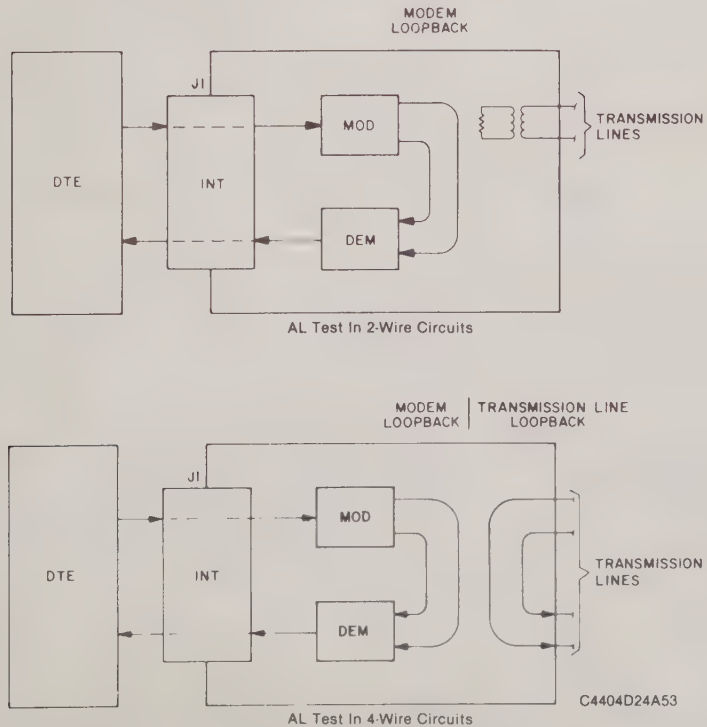


Figure 5-2: Analog Loopback (AL)

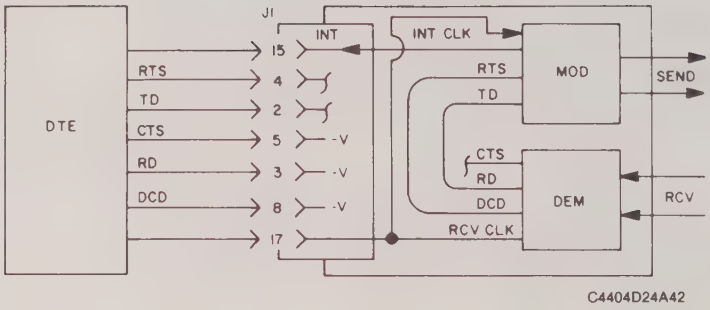


Figure 5-3: DTE/Modem Line Connections in Digital Loopback (DL)

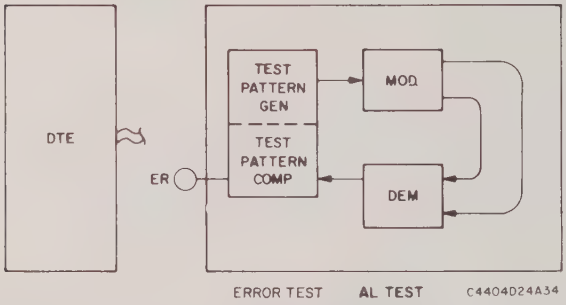


Figure 5-4: Modem Self Test, ET + AL Facilities

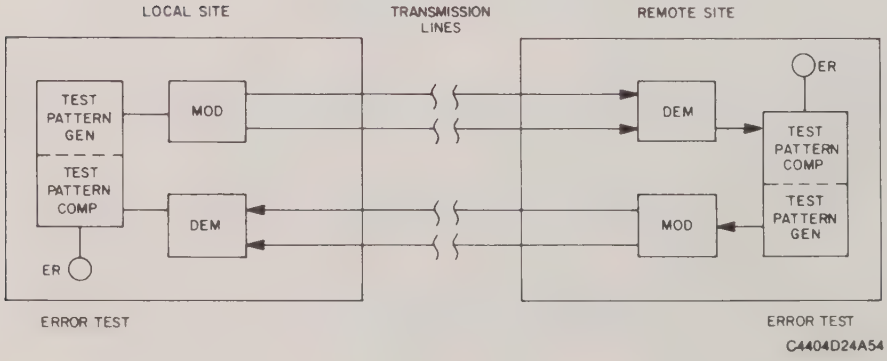


Figure 5-5: Four-Wire End-to-End System Test Using ET + ET Facilities

(2) Conduct a modem self test (Figure 5-4).

POINT TO-POINT NETWORK CHECKS

In a direct point-to-point configuration, remember that data transmission must be interrupted for the test. However, the testing scheme is uncomplicated and brief.

Perform modem self test (Figure 5-4) at both ends to eliminate the modems as the source of malfunction. Next, perform an end-to-end system test to check transmission line performance. Determine error count as described in CONFIDENCE TESTS.

MULTIDROP NETWORK CHECKS

In a Multidrop Network, if one drop only is running distorted data, initially suspect the transmission line drop, the modem and the DTE. Self test the modem. Set an analog loop (AL) in the modem to self test modem and DTE (See Figure 5-2). By testing modem and DTE first, it may not be necessary to shut down the entire network to test transmission lines.

When all data in the multidrop network appears to be distorted, initially verify the central site modem and DTE, as well as the main transmission lines. An efficient procedure is to first self test modem and DTE at the farthest drop. Next, self test central site modem and DTE. When modems and DTEs check satisfactorily, set up an end-to-end system test and determine error count between farthest modem and central site modem. This test will reveal the main transmission line performance.

COMPLEX NETWORK CHECKS

In more complicated network configurations, quickly analyze the malfunction by answering the following questions:

(1) In what area of the network does the problem seem to appear?

(2) Can that area be isolated and tested without interrupting data transmission throughout the network?

(3) What is the easiest and quickest method to test that area if, in fact, the network must be shut down?

FIELD SUPPORT

Modem 24 LSI MARK II provides high reliability through the use of large scale integrated (LSI) circuits, solid state components, and conservative rating of the components. Nevertheless, after careful checks and tests, as described in this section, a system fault may occasionally be traced to the modem. In that case, contact Racal-Milgo, Inc. Customer Support for service assistance. Refer to IMPORTANT INSTRUCTIONS TO USER whenever the modem is Feature D + R1 or D + R2.

When contacting the Racal-Milgo, Inc. Customer Support for service assistance, be sure to mention the identification provided on the nameplate on the rear of the modem.

Table 5-1: State of Modem Indicators in Test Mode

INDICATORS					
PUSH-BUTTON	**PWR and TST**	**ER**	**DCD**	**RD**	**RTS and TD**
RT	ON	OFF	ON if receiving signal. OFF if not receiving signal.	ON if TD is on. OFF if TD is off.	The state of RTS and TD indicators is directly controlled by the DTE in normal and test modes.
ET	ON	OFF	OFF	OFF	
AL	ON	OFF	ON if RTS is ON. OFF if RTS is OFF.	ON if TD is ON. OFF if TD is OFF.	
DL	ON	OFF	In switched carrier operation: ON if RTS is ON. OFF if RTS is OFF.	ON if TD is ON. OFF if TD is OFF.	
			In continuous carrier operation, always ON.		
ET + AL	ON	OFF if no errors	OFF	OFF	
ET + RT	ON	OFF if no errors.	OFF	OFF	

NOTE

At the remote site modem which has been forced into digital loop, the state of the indicators is the same as for DL in this table.

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